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A MODEL TO PREDICT URBAN INFLUENCED LAND PRICES

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A MODEL TO PREDICT URBAN INFLUENCED LAND PRICES

April 1986

Prepared by Donald James Weideman

The views and conclusions expressed and the recommendations made in this report are entirely those of the authors and should not be construed as expressing the opinions of Alberta Municipal Affairs.

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FOREWORD

The project documented in this report received funding under the Innovative Housing Grants Program of Alberta Department of Housing. In May 1986 the Alberta Department of Housing was amalgamated with Alberta Municipal Affairs which is now responsible for issuing this report.

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EXECUTIVE SUMMARY

A MODEL TO PREDICT URBAN INFLUENCED LAND PRICES

Increased development at the urban fringe generates a rapid rate of change in land uses and significant increases in property market prices. This study constructs and tests a model to predict the price of land located in the urban-rural fringe. The objectives are to estimate and analyze a land market price function to improve the investor/developer's rationalization of the market for land.

The objective is accomplished through the development of a predictive model of land prices and the estimation and analysis of this model for the Edmonton Regional Planning Area. First, the model is developed with hypotheses about the expected impacts on land price of the level of urban and regional economic development, accessibility to economic activities, site and location characteristics, institutional factors and land market activity. Second, a description of the study area, sampling procedure and the data are provided. Third, statistical estimates and their analysis are presented. Finally, economic conclusions and recommendations for future research are presented.

Regression analysis is used to estimate the hypothesized relationships in a series of linear and transformed variable single-equation models. Factor

analysis is applied to reduce redundancy among variables and to identify a smaller number of underlying factors. The predictive model of land transaction prices is applied to analysis of the data stratified by county location and land use to test the predictive capability of the model along these micro market dimensions. The model is validated by using the estimated model to predict transaction prices and comparing the results to actual transaction prices.

The statistical results and the performance of various models were evaluated for logical development of economic relationships which function in the land market. However, statistical influences, particularly multicollinearity, were major obstacles to achieving a model which would represent the land market in the Edmonton region. No one particular model was superior in illustrating the functioning of the land market in the urban-rural fringe.

I. INTRODUCTION

A. The Problem of Predicting Land Prices

Rapid expansion of metropolitan regions at the urban fringe create many land use and development problems. The solution to these problems requires an understanding of the urban development process and an examination of the relationships between land prices, location, and intensity of development. Land price plays a critical role in the allocation of land, thereby shaping the pattern of development.

A major portion of urban expansion occurs in the suburbs and at the urban fringe as people move outward from the congestion of the central city and others migrate to large urban concentrations from rural communities. Ottensmann stated:

> "The character of the residential development occuring at the periphery of a metropolitan area has extensive and diverse economic and social implications. The kinds and prices of housing produced, the population groups served, and the cost and problems of providing public services are all determined by the workings of the development process... An understanding of this process requires an examination of the relationships between land prices and the location and intensity of development... Land values play a critical role in the allocation of land, thereby shaping the pattern of development."[1]

Increased development at the urban fringe generates rapid rate of change in land uses and significant increases in real property market price. The impact of shifts in land use in the urban-rural fringe has increased the complexity of estimating property market prices. For example, land may be priced as an input factor in the production of agricultural products. However, it may be priced differently if it is considered for its potential expected value for urban purposes. Is it valued for its current use; for its value as a factor of agriculture production; or for its expected future value for urban use?

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[1] John R. Ottensmann, "Urban Sprawl, Land Values and the Density of Development," Land Economics, 53 vols. (1977), p. 389.

Therefore, the accurate prediction of land price becomes a problem for the investor/developer. A land price predictor model is required to improve the investor/developer's rationalization of the land market. The model would guide investors in their land purchase decision making relative to the location and timing of the purchase and the expected price of the transaction. The benefits of such a study could be more efficient functioning of the land market, as well as, a greater awareness among investors of the consequences of their purchase and development decisions on land market prices.

B. Objectives of This Study

Previous studies of land market prices have dealt almost exclusively with either urban or rural land. [2] In the urban-rural fringe, however, the land use pattern generally does not present clearly distinguishable classification. Rather, there is a gradual shifting of land from rural to urban uses. Accordingly, the determination of land prices becomes more complex because it involves estimates of the time distribution of shifts in use and resultant changes in land rent.

---

[2] Urban refers to platted residential subdivisions, and commercial and industrial properties. Rural includes farms, forest, and non-platted residential tracts.

This study will construct and test a model to predict the price of land located in the urban-rural fringe. The general purpose is to estimate a land market price function to improve the investor/developer's rationalization of the market for land.

The specific objectives may be summarized as follows:

1. To identify and describe the major determinants of land prices in the urban-rural fringe.
2. To determine differences in the effect of each factor on the price of land under various model specifications.
3. To validate the model by evaluating the differences between predicted and actual transactions prices.

The major assumption is that theoretically supportable land market price indicators can be empirically tested to predict prices for land. If this assumption is true, a model can be specified to be used for predictive purposes. The second assumption is that the relationship between the variables is sufficiently stable to provide suitable predictive capability. If these assumptions hold, a useful land market price predictor may have been discovered.

C. Urban Influenced Land: The Urban-Rural Fringe Defined

Rural land under the influence of an urban concentration has generally been referred to in the literature as land in the urban-rural fringe. Hushak indicates that the urban-rural fringe includes land along the boundaries of a city, in the suburbs, in small incorporated towns near the city and extending into the unincorporated, partially developed countryside surrounding the city.

It is the area where land is in transition from agricultural to urban use.[3] It is in the fringe area that urban demands for agricultural land are substantial and shifts from agricultural uses to urban uses are a major market phenomenon. It is the interaction of agricultural and urban market forces in fringe areas that complicate the estimation and understanding of land values.

From a spatial point of view urban influenced land, land in the urban-rural fringe, is generally considered to be a zone of transition lying beyond the corporate boundaries of an urban place. While the inner limits are fairly well defined in a legal sense, the outer edge of a fringe zone tends to be more obtuse and dynamic, encroaching steadily into the rural hinterland. Statistics Canada has defined the fringe as:

---

[3] Leroy J. Hushak, "The Urban Demand for Urban-Rural Fringe Land," Land Economics , 51 Vols. (1975), p. 112.

> "Part of a census metropolitan area or of a census agglomeration outside the urbanized core. It corresponds to the immediate zone of influence of a multi-municipal urban center. The concept of fringe is more restrictive in census agglomeration (CA), than in census metropolitan area (CMA) (in a CA, the fringe is composed of the remainder of municipalities having a part in the urbanized core while in a CMA, the fringe comprises all municipalities within a 20-mile radius of the urbanized core which meet established criteria related to the structure of the labor force and the population increase)".[4]

Russwurm developed a conceptual framework to describe a major urban concentration and the urban-rural fringe.[5] The broad functioning urban system is termed the regional city, which includes the built up urban area and the dispersed elements of the regional city or the urban field. This framework is presented in Figure 1.1.

The urban field may be very large, extending beyond 50 miles from the central city of cities of over a million in population. Within the urban field are various nodes dispersed within farmland: smaller cities and towns, villages, hamlets, country estate subdivisions, urban development and isolated country residential development.

The inner fringe represents land under development and in the advanced stages of transition from rural to urban uses. The outer fringe, which together with the inner fringe forms the urban-rural fringe, is an area where rural

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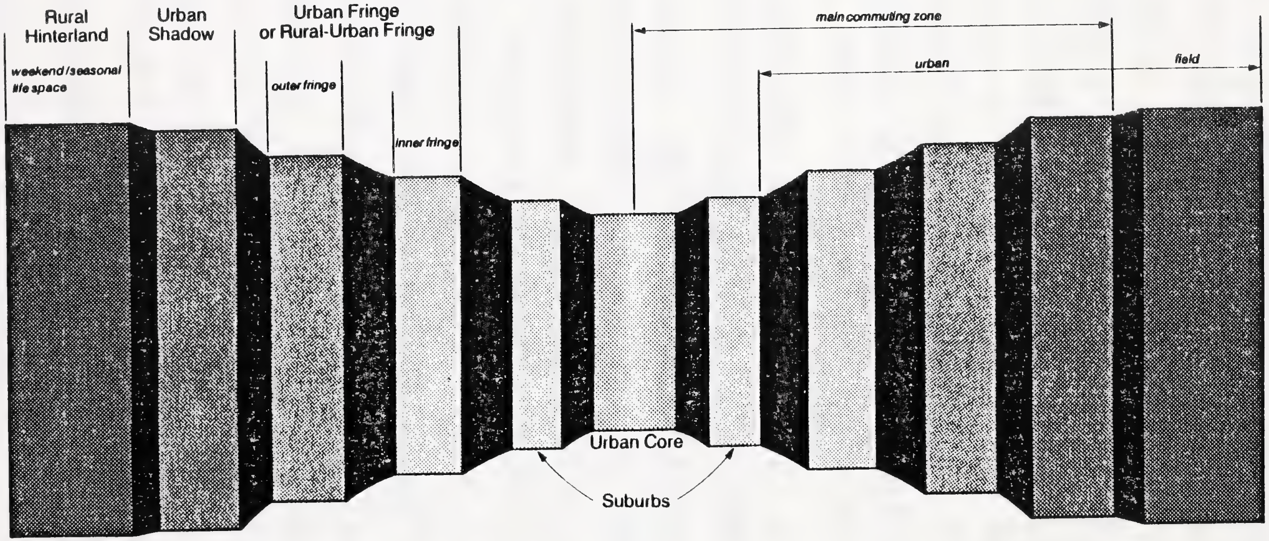
[4] Statistics Canada, Dictionary of the 1971 Census Terms, (Catalogue 12-540, December 1972), p. 50.

[5] Chris, Bryant, The Rural Real Estate Market, ser. no. 18 (Department of Geography, University of Waterloo, 1982), p. 3.

FIGURE 1.1
THE FORM OF THE REGIONAL CITY



Rural Hinterland
weekend/seasonal life space
Urban Shadow
Urban Fringe or Rural-Urban Fringe
outer fringe
inner fringe
main commuting zone
urban
field
Urban Core
Suburbs

Source: Chris Bryant, The Rural Real Estate Market, Department of Geography, University of Waterloo, Publication Series No. 18, 1982, p. 3.

uses dominate the landscape but where urban elements in the landscape are significant. The urban-rural fringe merges into the area of urban shadow, an area where physical evidence of urban influences on the landscape is small, but where such presence is felt in terms of nonfarm ownership of land and a scattering of nonfarm residences and country estates. Finally, the urban shadow gives way to the rural hinterland where urban influences are not completely absent with the presence of the cottage or weekend retreat.

One of the first geographers to describe the urban fringe phenomenon was Wehrwein, who recognized that the 'built-up' city is not necessarily coterminous with the political city.[6] In many cases the economic and sociological city, the area within which people live the urban way of life, has extended far beyond the city limits. Conversely, the farms upon which people live the rural way of life are found frequently within the political boundaries of cities.

Hassbring considers the rural-urban fringe zone surrounding Edmonton to be an area of mixed rural and urban land uses undergoing transition from rural to urban character, extending from the edge of the continuously built-up urban area, to an area in which agricultural land uses predominate.[7] Within this area are both incorporated and unincorporated places. Hassbring also feels that the heterogeneous nature of land use at the fringe has necessarily produced a similar occupational structure. The contiguity of urban development at the inner boundary has produced population densities that are considerably higher than the outlying rural hinterland.

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[6] George S. Wehrwein, "The Rural-Urban Fringe," Economic Geography, vol. 18 (1942), pp. 217-228.

[7] Margareta Hassbring, " Land Use Diversity in the Rural-Urban Fringe Zone of Edmonton," Albertan Geographer, vol. 6 (1970), pp. 59-64.

D. Scope and Limitations

The focus of this dissertation research is on the application of quantitative methods to predict land market transaction prices with emphasis on improving of the predictive capability of the model. The following three requirements for the model will be imposed:

1. The model must evolve out of a logically consistent framework, or theory.
2. The model must utilize constructs that correspond to measurable behavior or other phenomena in the real world.
3. The model must be easily tested empirically.

The specific research objective is to examine the relationship between land market transaction prices and the characteristics that influence the price of land surrounding a major urban concentration. The purpose of this examination is to identify a model capable of predicting land market transaction prices in the urban-rural fringe. Achievement of the following intermediate objectives are necessary to meet this purpose:

1. The determination of the relationship between changes in land price and a set of objective characteristics. This is to be accomplished by expressing the relationship in the form of the general linear model and testing the strength of the relationship using empirical data. Several forms of the model will be tested.
2. A test of the stability of the relationship over time to determine the predictive capability of the model. This is to be tested by using the model to predict prices of the dependent variable and comparing the results to actual prices.
3. Selection of a model shown to be most successful for predictive purposes and explanation of its use and limitations. The best performing model will be chosen with emphasis on reliability, problems of estimating values for the predictors and limitations to its use.

This study is based on the assumption that observed land market transaction prices are representative of the land market at a point in time and reflect market equilibrium prices. Therefore, the study will only consider land that has undergone a change in ownership during the study period. Subdivision of land that does not result in a transaction and a change in ownership is beyond the limits of this study.

This study will not attempt to develop mass appraisal methods for the prediction of value of specific individual properties. The resulting model will be intended for use in analyzing the movement of transaction prices in the market for raw land surrounding a major urban concentration. Therefore, the most appropriate application is for land market analysis as opposed to direct estimation of land values.

E. Study Area and Data

Land market transaction prices in the urban-rural fringe of the metropolitan area of Edmonton, Alberta, Canada are examined to estimate the theoretical model. Data includes a ten percent random sample of recent actual sales of land as obtained from Land Titles records for the general time period, 1971-1982.

Site characteristics and variable measurement are physically determined after plotting each individual sale observation on maps specifying the location of city boundaries, land use, subdivisions, shopping centers, satellite towns and main highway patterns.

F. Importance of the Study

At the conclusion of a paper that surveys recent developments in the field of theoretical urban economics, Richard Muth stated:

> "Suprisingly little attention has been paid to the empirical estimation and testing of models of urban

> spatial structure, relative to the amount of time we have spent on their theoretical development and elaboration. Yet it is principally through the former that shortcomings in such models are revealed and the way to their improvement is suggested".[8]

To overcome the lack of attention by researchers to the empirical estimation and testing of models this study intends to explore a technique to identify and estimate the factors which contribute to raw land market price. The result will be an estimated land market price function for land in the urban-rural fringe. In particular the focus will be on predicting land transaction prices.

Muller confirms the scarcity of research into land market prices due to development activity.

> "Changes in property value are treated more briefly than employment or housing. This reflects both the scarcity of analysis on this subject and the limitations of the tools used to estimate the effects of new development."[9]

The majority of urban economic models have taken a macro analytic approach. Generally, the reason given for this emphasis is the lack of sufficient data to allow empirical testing of micro economic models. However, Granfield recommends the use of micro models to analyze urban environments. He states:

> "Despite the paucity of present urban data, it is only with micro analytic models that we can hope to

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[8] Richard Muth, "Recent Developments in the Theory of Urban Spatial Structure," in Intriligator, ed. Frontiers of Quantitative Economics, Vol. 111B, (North-Holland Amsterdam, 1977), p. 369.

[9] Thomas Muller, Economic Impacts of Land Development: Employment, Housing and Property Values, (Washington, D.C.: The Urban Institute, 1976), p. 2.

> truly analyze and understand the inner workings of our urban environment and thus prescribe policies that will produce more useful results that now exist. Such micro models will also give some indication as to what variables should be examined (and data collected on) and those that can be safely ignored".[10]

On an applied level the accurate prediction of land market price is a problem for the investor/developer. This study will focus on the estimation of a land market price predictor model with the objective of improving the investor/developer's rationalization of the market for land. The results should guide investors in their land purchase decision making relative to the location and timing of the purchase and the expected price of the transaction. The benefits of such a study could be a more efficient functioning of the land market, as well as, a greater awareness among investors of the consequences of their purchase and development decisions on land market prices.

A model of land market transaction prices would help to identify relevant variables that systematically affect price and assist the investor/developer in the prediction of movement of prices in the market for land. The results are expected to measure the most important variables affecting the transaction price of raw land. Analysis will be made of changes in land prices over time, over space, relative to property location and site characteristics, relative to land use, land market factors, and institutional characteristics.

---

[10] Michael Granfield, An Economic Model of Residential Location, (Massachusetts: Ballinger Publishing Company, 1975), p. 9. Also see pp. 7-14 for more detail on Urban Model Building.

The specific model to be estimated in this study has direct application only to the delineated study area. Direct application and inferences to other geographic locations or time periods cannot be made with confidence. However, the techniques and data sources used to estimate the model are generally available. Therefore, the study also offers opportunities for further research to validate the results in other geographic locations and under different time periods.

G. Organization of the Thesis

Chapter I is introductory and includes a discussion of the research problem, objectives, importance of the study, outline of the approach to the problem and a description of the organization of the dissertation.

Chapter II presents a review of the theoretical literature and previous empirical research on urban-rural fringe land prices. Previous research in the fields of urban economics, regional economics, land economics and economic geography is reviewed to explore the characteristics of raw land under the influence of a major urban concentration. A set of land market price indicators are identified from the literature on land value, location theory, land use and spatial allocation models.

The review of theoretical and empirical literature in Chapter II delineates a number of factors which influence land prices. The purpose of Chapter III is to restate these factors in mathematical form and to develop appropriate statistical methods to test the hypothesized relationship. The chapter contains discussions of the proposed land price predictor model for study, the data and the methods of analysis. Statistical estimation techniques, the nature of the independent variables, study area description, data collection procedures and statistical problems are also discussed.

Chapter IV presents a description of the study area and each of the variables, including data sources and variable measurement and calibration criteria.

The general models and variables described in Chapter III are used in Chapter V to estimate a model to predict transaction prices of land in the urban-rural fringe. Various model formulations are estimated in order to determine which variables have an influence on land transaction prices and thus improve the predictive power of an equation. Factor analysis is used to identify and simplify the dependence structure of the independent variables. As well, a number of different transformation measures and variable interaction effects of some independent variables are compared to determine which variable provides a superior predictive power.

To test the hypothesis that the land market in the urban-rural fringe study area can be conceptualized as submarkets, where the factors influencing land values are significantly different from each other, the general model is estimated for sales data segmented by county location and land use. The equations which appear to be the best predictors of transaction prices of land in the urban-rural fringe are presented in this Chapter along with their statistical results.

Chapter VI reviews the major components of this research study with a presentation of the summary and conclusions of the work. It examines statistical and economic interpretations as well as develops economic conclusions and implications. The chapter concludes with an evaluation of the research techniques used in this study and offers recommendations for future research on land prices.

II. REVIEW OF THEORIES AND PREVIOUS EMPIRICAL RESEARCH ON URBAN-RURAL FRINGE LAND VALUE

Previous research in the fields of urban economics, regional economics, land economics, and economic geography is reviewed in this chapter to determine price characteristics of land under the influence of a major urban concentration. The specific topics of interest in these fields include land value studies, location theory, land use and spatial land allocation models. This body of knowledge has produced a number of divergent approaches to explain the evolution of an urban area, its interrelationship with the region and how growth and development of the city influences the market price of land in the urban-rural fringe.

Urban growth phenomena are among the most difficult to cope with because of their variability, the frequency with which they occur and because of the large number of people affected. However, in spite of the apparent complexity of urban structure the following discussion will focus on several major approaches to urban spatial analysis and relate these theories to the factors that affect the price of land in the urban-rural fringe.

This chapter reviews the major theoretical work and previous empirical research related to urban and rural land price. The objectives of this review are to examine theoretical models which conceptualize the process of land value creation and to identify the indicators from which a land price predictor model will be derived. The review provides the basis for the development of an empirical model of urban influenced land price and assists in the selection of appropriate variables for consideration in the development of the empirical model. The process of the model formulation and a description of the variables, including the constraints to variable selection, are described in Chapter III.

The purpose of this study is to formulate a model to predict land transaction prices in the urban-rural fringe. A theoretical base is required to determine the nature of the variables for use in model formulation before quantitative methods are applied to analyze and improve the predictive capability of the model. Variables selected on the basis of accepted land value theories are expected to enhance the models predictive reliability.

This chapter presents a discussion of land economics theories which are concerned with urban spatial structure and the distribution of land values within the urban area. The spatial relationship of location, land use characteristics and price is the focus of this review. Theoretical land value models are evaluated for the development of an empirically tested model to predict urban influenced land transaction prices. Variables that may be used to formulate such a model are delineated from the theoretical sources reviewed.

A review of previous empirical research follows to determine how the identified theoretical variables have been adapted for empirical testing. The variables selected, based on previous empirical research, to be used in the model specification and estimation procedure are described in Chapter III.

A concluding summary includes comparison of the underlying theoretical classification of land value indicators used by previous researchers which will be used to formulate the land transaction price predictor model.

A. Land Value Theories

Several principles of classical land economics theory have implications for the value of land under the influence of a major urban concentration. These theories of urban spatial structure and residential location are concerned primarily with land values and their distribution within the urban area. The theoretical base for the proposed dissertation research stems from the classical work of Ricardo, Von Thunen, Alonso, Burgess and Hoyt on the spatial relationships of location, land use and value.

Theory Of Land Rent

Initial theory related to land values was oriented mainly towards agricultural land. The concept of land value was described as land rent by Mills. In the same manner as the wage rate is the price of labor services, land rent is the price of services yielded by the land during a specified time period.[11] Assuming that factor and product markets are perfectly competitive, and that people own productive land and capital only because of the returns they yield, then, all equally productive land will command the same price or rent.

Ricardo viewed land rent based on the notion of land fertility.[12] The most fertile land is put to use first since it requires the least land and the smallest amount of nonland inputs relative to output. As population increases, less productive land is then used as the demand for agricultural product increases. Further population increases will cause lower quality land to be put into production, and rent will immediately accrue to the highest or first quality lands. The amount of rent depends on fertility differentials and the process will continue until the margin of production for the existing conditions is reached. As a result, land rent at any fertility level is proportionate to the excess of the productivity of the land at that level over the productivity of the least productive land in use.

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[11] Edwin S. Mills, Urban Economics, (Glenview, Illinois: Ecott, Foresman and Company, 1972), pp. 37-39. See also Chapter three pp. 37-50 for a discussion on land rent.

[12] David Ricardo, "On the Principles of Political Economy and Taxation," (1817) found in Piero Sraffa (ed.) The Work and Correspondence of David Ricardo , (Cambridge, Massachusetts: Cambridge University Press, 1951).

Land rent is a residual equal to the excess of revenues from the sales of produced goods over expenditures for nonland factors used in production. The analysis of land value is then focused primarily on fertility differentials. In the long run, it is this economic rent which tends to determine the spatial distribution of land uses and land values.

It is more useful to consider the theory of location differential rent developed by Von Thunen.[13] He applied location theory to agriculture when he described the effect of the central market place on agricultural land use and land value. The city is surrounded by a plain of uniform fertility in which the city's food is grown. Food can be shipped straight to the city from any point on the plain. Transportation cost per mile is constant so that the land farthest from the city brought into production commands rent of zero, and the rent increases with land located closer to the city. All the land at a given distance from the city commands the same rent.

The rent at any point on the plain is the value of the point's product minus the production and transportation costs incurred at that point. The rent, then, determines the agricultural land uses around the market city because products of higher value can bid higher prices for the use of land which is assigned to the highest bidder. This causes a number of concentric rings to be formed around the market. Each such ring is devoted to the production of a particular good; and they occur in decreasing order of unit prices with increasing distance from the market. Land rents will decrease with distance from the market for the whole system of crops due to increased transportation costs.

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[13] Johann Heinrich Von Thunen, Von Thunen's Isolated State, ed. Peter Hall (London: Pergamom Press, 1966).

The Ricardo/Von Thunen model of agricultural production became the basis of the literature on urban land values and spatial structure which is best represented by the work of Alonso.[14] He conceives of the city as a featureless plain with all production and distribution activity concentrated at the center of the central business district. The population is uniform with respect to family size, demands for space, income, trips to the central business district and so on. Finally, building costs are assumed to be uniform throughout the city and transportation costs are proportional to distance travelled. Site values differ by the difference in transportation costs associated with living at the respective distances from the central business district.

From Alonso's theory it may be concluded that the desire for accessibility to the urban center might be expected to result in continuous development extending out from that center, since people seek more accessible locations and are willing to pay more for them.

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[14] William Alonso, Location and Land Use, (Cambridge, Massachusetts: Harvard Press, 1964).

Wingo developed a similar model through which households minimize their location costs by choosing between the size and accessibility of a site.[15] The preference between size and accessibility are treated independently, while rent and transportation costs are assumed to be complementary. Wingo adds a budget constraint where households spend a constant amount for both land rent and transportation costs. This is equal to the transportation costs to the most distant location where the price of land is zero.

Muth presents a more complete analysis of residential location through his specification of housing services which combines land, size and housing structure and other dimensions of housing value.[16] He also considers household income as one of the determinants of transportation expenditure. Analysis of the change in the bid-rent function with respect to income concludes that an increase in income will move the equilibrium distance further from the center. In addition, household residences will be stratified along radii from the central business district with higher income families residing farther from the center than lower income families.

In his paper Muth considers the problem of how land rents and uses are determined by a competitive market. He gives particular attention to how the equilibrium uses and rents change with changing market conditions. Muth develops a theoretical model concerned with the long run equilibrium of competing industries of which one industry produces non-farm housing services and the other industry produces agricultural commodities. His model is a mathematical model that is not tested empirically.

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[15] Lowdon Wingo, Jr., Transportation and Urban Land , (Baltimore, Maryland: The John Hopkins Press, 1961).

[16] Richard F. Muth, "The Spatial Structure of the Housing Market", Papers and Proceedings of the Regional Science Association, Vol. 7, (1961), pp. 207-220.

The models discussed above may be classified as economic equilibrium models which are basically abstractions of reality with many simplifying assumptions. These approaches are based on economic theory and analyze the behavior of individual households as units which seek to maximize their satisfaction through rational decisions regarding the purchase of necessary goods and services, including housing.

Interacting with the economic equilibrium models are spatial organization concepts which are concerned with the general shape, land use and spatial organization of the city. Spatial theory is discussed in an application of land use concepts to land value.

Spatial Theory of Land Use

Burgess developed a concentric zone approach to explain the expansion and land use structure of cities, which in many ways parallels Von Thunen's explanation of rural land uses.[17] The circular zones show that the influence of a large city center over its surrounding area diminishes with increasing distance. They also reflect that the spatial structure of land use within the city is determined by the accessibility needs and preferences of firms and households.

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[17] Ernest W. Burgess, "The Growth of the City," American Sociological Society-Papers and Proceedings, 18

Aside from the loop containing the central business district, the rings of the city are characterized by income-level residential land uses. Thus, the second zone contains poor and old residential property and run-down areas that have been invaded by business and light manufacturing as the CBD expands. The third zone, that of workingmen's homes, includes residences in close proximity with industrial plants. These homes have the double advantage of low rents and ease of commuting to work. The fourth zone is a high class residential area, while the fifth is one of residential suburbs and satellite development within commuting distance to the central city. As growth occurs, each zone tends to extend its area by invading the next outer zone in sequence.

Hoyt modified the concentric zone theory of Burgess to provide for a sector theory of urban growth in which particular land uses are formed in various sectors tending to expand outward along principal transportation routes and along lines of least resistance.[18] The main argument is

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[17] (cont'd) vols. (1923), pp. 85-99.

[18] Homer Hoyt, The Structure and Neighborhoods in American Cities, (Washington, D.C.: Federal Housing Administration, 1939).

that different income groups tend to live in district areas which, instead of occupying entire rings around the central business district, are sectors around it. This tendency is strengthened by new retail establishments who are also moving outward.

Theory of Location

Location theory provides another, though not independent, theoretical framework for land value analysis. It is an extension of the theory of rent which asserts that location, in addition to land quality, is a prime determinant of land rent.

Location affects the manner in which land is used by a transportation cost function. As the distance between the market and production site increases, the cost of transporting inputs to the production site and the product to market also rise. As a result, net land earnings capitalized into land values are reduced. Land closest to input and product markets normally commands the higher rent. Therefore, for land used primarily as a productive agent, a negative relationship is expected between its value and distance to market.

Ratcliff provides an introduction into the physical and locational characteristics of real estate which give it economic value.[19] In the case of agricultural land, the value of the land is derived largely from its physical characteristics of fertility. However, location plays a major role in the case of urban land value.

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[19] Richard V. Ratcliff, Real Estate Analysis, (New York: McGraw-Hill, 1961), see in particular Chapters III and IV, pp. 42-80.

> "The location of the land, the space relationships with other urban facilities and activities, not only largely determines the use to which each parcel may be put but also does much to explain its productivity and value". [20]

Physical features that affect land value include natural geological conditions, human modifications such as grading or filling, provision of infrastructure and the structural improvements which become physically part of the real estate. The concept of location is given meaning when referred to a specific site, a particular use, a given environment and a specific time. Convenience and accessibility are the prime factors that influence locational value where urban activities tend to gravitate to locations which promise the maximum economy of movement to and from linked activities.

Theory of Supply and Demand for Land

In general, the concepts of supply and demand have the same meaning when applied to land as to other economic goods. The supply schedule reflects quantities of land offered and the demand schedule the quantities that would be purchased at a given time at various prices. In competitive markets prices determined by the interaction of

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[19] (cont'd)

[20] Ratcliff, p. 43.

supply and demand reflect land values. However, an understanding of the characteristics of supply and demand for land is required to understand price movements and land use.

In considering land supply, distinction must be made between physical quantities and quantities of land resources. In the physical sense, the supply of land is perfectly inelastic. The total geographic area of land is fixed. This does not mean though, that the area offered for sale in a local market will not vary with price at any given time. In addition to this spatial dimension of land supply, intensity of use contributes to effective supply through the flow of services and creation of land resources. The quantity of service flowing from land is related to the level of technology. Advancing technologies increase effective supply. [21]

Within a local market context, Hushak builds upon this concept of a fixed supply of space to investigate empirically variations in the market prices of undeveloped land parcels around an urban center.[22] Conceptually, the quantity offered or made available by land owners interacts with the demand of those who would like to own land, acquisition demand, resulting in observed market prices. If both acquisition and reservation demand (total demand) are considered, equivalent market prices are determined by interaction with the inelastic supply of land. Brigham uses a similar argument as the basis for investigating the determinants of Los Angeles residential land values.[23]

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[21] Barlow describes the spatial limits of land supply for alternative uses and the arguments which influence this supply beginning on page 3 in Land Resource Economics, (Englewood Cliffs: Prentice-Hall, 1978).

[22] Leroy J. Hushak, "The Urban Demand for Urban-Rural Fringe Land," American Journal of Agricultural Economics vol. 61, n. 4, (1979), pp. 697-702.

Total demand exists for land because of the uses to which it can be put to satisfy human wants. For the most part, this demand is a derived demand. Few individuals seek land for its own sake, but for what it produces. The productivity and the value of land are derived from its ability to be used beneficially by people.

The basic factor related to the derived demand for land is population and growth. This factor interrelated with others such as level of income, technological developments and innovations, general price level movements, individual tastes, customs and traditions influence land demand.[24]

Therefore, land supply and demand are the market effects of the relative scarcity and utility associated with land as an economic good. Their interaction results in market transaction prices. Under perfect competition these prices are synonymous with economic value. Complications arise because of land market imperfections and the unique features of land.

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[23] E. Brigham, "The Determinants of Residential Land Values", Land Economics, (1965), pp. 325-334.

[24] Smith, Tschappat and Raster discuss these determinants in an urban context in Real Estate and Urban Development, (Homewood, Illinois: Irwin Inc., 1977) beginning on page 137. Barlow, p. 47 approaches the demand for land and demand determinants from a broader perspective.

Traditional Value Theory: The Income Model

In the urban-rural fringe expectation of development causes land to shift in use. Whether the shift in use is within or between the broad classes of rural and urban land, income in the form of capital gains results from increases in land value. Value does not only depend on estimated income in present use and its capitalization rate, but also reflects the income from the new use and its capitalization rate. Capital gains accrue over time and are a part of the actual transaction price of the land.

Within an effective market structure, the price resulting from the interactions of land supply and demand can be viewed as the discounted value of benefits that are expected from land in the future. For conceptual purposes, benefits can be confined to financial rewards. In a static competitive market framework, the rewards are generally termed net rents. In this context, because of the fixed characteristic of land, net rents are equivalent to residual income resulting from the beneficial use of the land.

The emphasis for theoretical purposes has been mainly on land rents at a point in time. Empirical observations are usually land values measured by transaction prices resulting from capitalization of rent. In a dynamic context, land value, as the capitalization of rent, is given by:

$$LV = r/I$$

where:

LV = land value,

r = constant annual rent, and

I = interest rate.

For short run analysis, interest rates, expectations, and taxes are given. Land value depends then upon the annual return to land. Agricultural land values in the urban fringe should recognize expected gains from conversion to urban use, as well as the rent associated with agricultural use. If farm income continues until the time of development, land value becomes:

$$LV = r/Ia + Ce/(1+Ic)^{t}$$

where:

Ia = the interest rate for capitalizing annual rent,

r = annual rent,

Ce = expected capital gains,

Ic = the interest rate for capitalizing expected gains, and

t = number of years over which rent (r) is expected to continue before capital gains are received.

Despite the fact that capital gains have been identified in numerous studies as an important factor affecting the value of land, considerable difference of opinion exists among land economists and statisticians as to whether this variable can adequately be modelled, particularly in a cross-sectional analysis. The primary source of concern centers around the way in which this variable is measured in most land value studies.

The value of fringe area land reflects both current use and expected use. With complete knowledge the gains will be fully and accurately discounted into land values and reflected in transaction prices. In this regard Clawson states:

> "If there was complete knowledge as to the time of future conversion, as to value at that time, as to holding costs and as to discount rate, ...everyone would be in complete accord as to present worth. There would be no opportunity for speculative gain, because all future value would have been fully and accurately discounted into present value."[25]

Theory of Urban Development

Explicit in the theory of urban development is the notion that economic activity is spatially oriented. Hence, if economic activity affects land values, it does so at different rates among locations and over time. Most economists agree that it is the growth in population and expansion of urban-rural communities which gives rise to the nonfarm demand and scarcity of agricultural land. Therefore, factors which affect incomes, accessibility, rates of capitalization, and the direct satisfaction derived from the ownership of land affect its value.

Some agricultural land is closer to urban centers than others. Agricultural land markets closest to these centers tend to have higher prices for several reasons. Generally, this land is the first to be bid up as industries and people seek expansion in suburban locations. Economic growth requires expanded services, transportation facilities and other factors affecting the derived demand for land. Thus, urbanization provides new opportunities for urban-rural population and thereby places additional demands on land and its services.

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[25] Marion Clawson, "Urban Sprawl and Speculation in Suburban Land," Land Economics, vol. 38, (May 1962), p.104.

Theory of Highest and Best Use

As a general rule, rational land owners use their land for the alternatives that provide the highest rate of return.[26] This return may take the form of monetary return or satisfaction. Land is considered in its highest and best use when it is used where it has the highest comparative advantage relative to other uses. Demand for land for various uses and the highest and best use concept combine in arriving at the actual use of the land. For example, a certain parcel of land may meet the criteria for an industrial site; however, there may be no demand for industrial land in that geographic area.

Land can generally be classified in a hierarchy of uses. As general characteristics of the land change, land tends to move up the classification scale to a more intensive use with a higher rate of return. Accessibility to locations such as cities, towns or employment areas can dictate the necessity of a change in use.

Land generally moves from natural wilderness to forests and grazing as man first settles an area. As more people move into an area, the land is generally converted to cropland and permanent pastures.

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[26] For a detailed presentation of the evolution of this concept, see Paul F. Wendt, "Highest and Best Use: Fact or Fancy," Appraisal Journal, vol. 37, (October, 1969), pp. 485-500.

As towns and then cities develop in a region, the surrounding land tends to increase in value. This increase in value, generally is not caused by an increase in the agricultural commodities produced but because of the demand for residential land located near the town or city. Urban population tends to outbid the farmer for land and thus this land is bid out of agricultural uses and into residential uses.

As further increases in population occur, commercial and industrial developers tend to look upon the area as a possible source of employees and as a market for consumer goods. Also, because of the reduced transportation to market costs and the urban services provided by the area, commercial and industrial developers find that a comparative advantage exists in locating near or in an urbanized area. The advantage of highway systems, utilities, and an adequate supply of skilled and unskilled labor far outweigh the advantage of the lower prices of land in rural areas. For these reasons, industrial developers are willing to out bid the agricultural and residential purchasers of land.

Thus, a hierarchy of land uses exists starting with land in its natural state, evolving into crop land and pasture land, then into residential home sites and finally into industrial and commercial building sites. It can be seen that not one but at least three distinct land markets exist (agricultural, residential and commercial) depending on the comparative advantages of the land with respect to surrounding tracts of land.

Summary

Building on a brief discussion of land supply and demand, a conceptual framework has been suggested for a static evaluation of land values. Land values vary because of the variation in the value of the marginal productivity of land which is a function of physical and transfer characteristics. Different land characteristics contribute differently to the value of land depending on use. In urban fringe areas, agricultural land values reflect expected gains from future urban use.

In summary, the variation in level of economic activity over space appears to generate variations in land value over space. Gradients of land values stem primarily from differences in incomes, accessibility, social mobility, speculation or investment, subjective preference for land ownership, and site value.

B. Review of Empirical Research on Land Price Predictor Models

The use of statistical techniques, especially regression analysis, in the valuation of real property has received varied attention in current empirical literature. Early empirical research into land value concentrated on agricultural land and was concerned with productivity value as measured by soil classification indexes and crop yields. Historical land values and value-trend studies were the focus of this research. Research concentrating on the determinants of urban residential property values has been limited in scope to the study of neighborhoods or land at the periphery of an urban area.

Many of the models surveyed and discussed below are conceptual and do not use actual land transactions as observations. Most studies included in this analysis have also been static in nature and do not recognize the influence on value of changes in the variables over time. None of the studies took into account the influence of size of an urban area on value nor did they consider the value determinants of raw land located at any significant distance from the city boundaries.

Studies of Agricultural Land Values

Although early empirical research into land value concentrated on agricultural land, there was a general awareness that the farm sector was not isolated. The exclusive use of agriculturally oriented variables, such as soil classification and crop yields, seriously under estimated land values as demonstrated by actual land market prices. This led to the use of non-agricultural variables in the future studies.

One of the first studies to relate non-agricultural variables to actual land market prices for assessment purposes by Ottoson, et al concluded that land is not a homogenous product and different buyers emphasize different characteristics.[27] When soil productivity, location and land improvements were correlated with actual market prices a coefficient of multiple determination of 0.61 was attained. The addition of parcel size as an independent variable increased R^2 to 0.708. However, it was found that location was not significant to agricultural users and that parcel size, although inversely correlated with value, enhanced the significance of location.

This analysis led to the conclusion that because of non-uniformity in attributes of land parcels, use of sale price for assessing agricultural properties fails to consider use changes or urban influences. Variation in land values was attributed largely to errors on the part of buyers or to exogeneous factors. However, the exogeneous factors were not listed.

Up to this time, actual relationships between farm and nonfarm variables generally were not included in analyses although references to such relationships occurred. Scharlach and Schuh emphasized this fact and made efforts to link the farm and nonfarm sectors of the economy through the land market.[28] Their analysis focused on various nonfarm influences on agricultural land markets in a non-lagged model. In an eight-variable regression equation, 89 percent of the variation in value of land and buildings per acre was explained. Such nonfarm determinants as population density, distance from Chicago, and the property tax per acre were included. These variables were used to provide a measure of nonfarm influences in the agricultural land market.

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[27] H.W. Ottoson, A.R. Aandahl, and L.B. Kristjanson, "A Method of Farm Real Estate Valuation for Tax Assessment," Journal of Farm Economics, vol. XXXVII, (August, 1955), pp.471-483.

[28] W.C. Scharlach and G.E. Schuh, "The Land Market as a Link Between The Rural and Urban Sectors of the Economy," Journal of Farm Economics vol. XLIV, (December, 1962), pp.

Scofield indicated that farmers, though not unaware of capital appreciation, could not afford to commit their capital and assume debts solely for capital gains.[29] Farmers base the prices they are willing to pay on the productive income of the land. However, he indicated that net farm income could no longer be used to measure land value since nonfarm buyers interested in capital gains bid the price up. The implicit conclusions were that no bona fide farmer would buy land with urban potential, and that returns from farming above living expenses will not cover holding costs and debt amortization while land was in a ripening stage of development.

Herdt and Cochrane analyzed supply and demand conditions as related to the agriculture land market. They applied a simultaneous equation model to time series data in deriving supply and demand functions for the farm land

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[28] (cont'd) 1406-1411.

[29] W.H. Scofield "Land Prices and Farm Earnings", Farm Real Estate Market Developments, (Economic Research Service, U.S. Department of Agriculture CD-66, October, 1964), pp. 39-47.

market under different levels of technology. Notably, they emphasized the importance of proximity to urban areas as being a value determinant used by farmers and nonfarmers alike. Their conclusion was that

> "...the expectation of rising income from technological advance in conjunction with supported farm prices and increasing urban demands has been important in contributing to the rise in farm land prices."[30]

Research on Urban Land Values

Measures of urban accessibility have received the most attention of any other variable in land value models. The hypothesis that land values tend to decrease with distance from the central business district has been empirically tested a number of times.

Using tax assessment appraisal record data, Brigham studied a sample of land values in the Los Angeles area using three rays emanating from the Central Business District (CBD) to select sample blocks.[31] Measures of accessibility, amenities, and topography were used as explanatory variables along with dummies to differentiate the three rays. The accessibility measures used were air line distances to the CBD, roadway distance to the nearest freeway exit, and a weighted average of employment levels in various employment centers within the urban area.

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[30] R.W. Herdt and W.W. Cochrane, "Farm Land Prices and Farm Technological Advance," Journal of Farm Economics, vol. 48, (May, 1966), pp. 243-263.

[31] Eugene F. Brigham, "The Determinants of Residential Land Values," Land Economics, (1965), pp. 325-334.

Brigham argues that if access to the CBD is equally easy in any direction, then distance from any site to the CBD is a good index of site accessibility.

Other explanatory variables included were income levels, percent non-white population, crowding, average building values, and a dummy variable to distinguish mountain sites and other sites. Linear regression equations were fitted to five-block moving averages with land value per square foot for single-family properties as the dependent variable. Because of inter-correlation, all accessibility and amenity variables were not used simultaneously. Distance to the CBD, income levels, building value, and topography were significant, had their expected sign, and explained 87 percent of the variation in land values along ray 1. Along ray 2 these variables, with crowding replacing income levels, also accounted for 87 percent of land value variation.

The smallest correlation coefficient between any pair of the three accessibility variables was .89 and air line distance to the CBD was the most useful in explaining land values. The correlation coefficients between land value and the distance to the CBD were -.89 and -.68 respectively, for ray 1 and ray 2.

Downing bases his analysis of Milwaukee residential land values on the premise that site value for residential purposes is the result of its natural desirability and the activities of man that change its natural desirability.[32] Sales price per square foot was used as the dependent variable in estimating regression models. Data for all sales of residential land for the years 1958 through 1962 were used to estimate the models.

The preferred model included the reciprocal of distance to the CBD, four zoning dummy variables to reflect different allowable development densities, the percent of dwellings in the block deteriorating or dilapidated, median education level and income level for the census tract in which a sale is located, and time (1960 = 0) as explanatory variables. R^2 was .72. The reciprocal of distance, the two highest density dummy variables, median education and income were positively related to residential land values while the other variables were inversely related to land values. All coefficients of the explanatory variables were significant except income and the two lowest density zoning dummies.

Lot size, distance to nearest regional shopping centre, distance to nearest grade school, and crowding were tried and dropped from the preferred version of the model because of their low explanatory power. Downing also noted that since his study dealt with the value of land on which construction was expected shortly after which tax reassessment would take place, sales prices were not expected to be influenced by pre-sale tax assessments. He notes that even with the strong decentralization of the past twenty years, there remained a strong attraction to living near the Milwaukee CBD.

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[32] Paul B. Downing, "Estimating Residential Land Values by Multivariate Analysis," In The Assessment of Land Values, (Madison: The University of Wisconsin Press, 1970), pp. 101-124.

Research on Land Values in the Urban-Rural Fringe

Not many of the empirical studies reviewed have concentrated on land values in urban influenced areas where agricultural and urban forces interact and complicate the estimation and understanding of land values. The notable few researchers who have concerned themselves with urban influenced land located at the urban-rural periphery are Adams et al., Clonts, Hurshak, Hurshak and Sadr and Chicoine. Comments on the focus of their research follows.

In a study of Northeast Philadelphia over the period 1945-1962, Adams, Milgram, Green, and Mansfield attempted to specify the various influences affecting the price of vacant land.[33] Special emphasis was placed on the movement of prices over time for the same parcel or subdivision of that parcel. Using pooled, cross-sectional, time series data consisting of 1,111 transactions of vacant land, 10 acres or larger in size, the authors estimated a mixed logarithmic-semi-logarithmic equation.

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[33] F. Gerald Adams, Grace Milgram, Edward W. Green and Christine Mansfield, "Undeveloped Land Prices During Urbanization: A Microempirical Study Over Time," The Review of Economics and Statistics vol. 50, (1968), pp. 248-258.

Separate estimates were made for residential, commercial, and industrial classes of property. Parcel characteristics included in the preferred regression for residential property were travel time to downtown Philadelphia, distance to two major arteries, a dummy variable for location on a major artery, and dummy variables reflecting state of development, presence of a trunk sewer, and zoning density. The growth rate of vacant land prices was estimated at 9.7 percent per year. The coefficient of multiple determination was .60. Estimates of the model for commercial and industrial properties were less successful than the estimated residential model. As expected, distance to downtown did not have a significant effect on the land price variation of industrial and commercial properties. Location relative to a major artery continued to be a significant explanatory variable.

The authors conclude that long run price trends of residential and commercial land were close to a normal return, meaning that the development trend of Northeast Philadelphia was anticipated early and capitalized into real estate values. In contrast, the growth rate of industrial land prices was very high, indicating the occurrence of either substantial shifts in expectations or failure of the model to hold other influences constant.

Clonts classified rural unurbanized properties in Prince William County, Virginia, into five groups and drew a geographically stratified sample of 501 parcels from tax assessment records to estimate a model explaining variation in land value per acre and per lot.[34] Property classifications included residential properties in platted subdivisions, tracts of farmland, rural residences, commercial and industrial properties, and forest and open idle land. Estimation of linear models indicated that the more important explanatory variables in the analysis were improvements on the land, location, access to major highway routes, and lot or tract size. Variables related to urban development explained 30 to 99 percent of the variation in land values.

Clonts concludes that the probability of converting a tract of land from rural to urban use in the foreseeable future is important in explaining urban periphery land values. For agricultural land, urban development related variables explained 53 percent of the variation in per acre values. Prince William County is on the periphery of the Washington, D.C. area.

Hushak found the reciprocal of tract size, distance from Columbus, distance from a second major city, location relative to a railroad, commercial zoning, and real property tax rates to be significantly related to the variation in per acre land values in the urban fringe of Columbus, Ohio.[35] A sample of 225 arms-length 1972 transactions of undeveloped land from seven counties were sampled from deed records to estimate a linear model to explain land value variation per acre. R^2 ranged from .48 to .71. Factors found not to be significant included location in an incorporated municipality, size of tract, and agricultural zoning.

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[34] Howard A. Clonts, Jr. , "Influences of Urbanization on Land Values at the Urban Periphery," Land Economics, vol. 45, (1970), pp. 489-497.

[35] Leroy J. Hushak, "The Urban Demand for Urban-Rural Fringe Land", Land Economics, vol. 51, (1975), pp. 112-123.

Hushak found the total sales value for both buildings and land per acre times the ratio of taxable value of land to total taxable value to be the dependent variable measure that best adjusted for the removal of building values. Regarding the significant and positive relation found between 1/size and variation in land value, Hushak concludes that this supports the hypothesis that a buyer of land pays less per unit for a larger parcel.

Other implications noted are: large lot zoning of residential housing may impose large costs on owners of undeveloped land through reduced property values; land use zoning policies can generate large economic values on properties zoned for commercial use; and although there is a negative and significant relationship between land prices and property tax rates, the impact of property taxes on land prices is small compared to other factors.

Hushak notes that urban development plans may be expected to have little influence in the face of pressures from landowners and public officials motivated by the possibility of large financial and tax base gains, respectively, when zoning decisions are made. Also, differential tax policies to prevent idle land should not be expected to be effective because of the marginal effect property taxes have on fringe area land values.

Chicoine developed a model which does not use the conventional supply and demand approach since heterogeneity of land violates the homogenous products assumption underlying these conventions.[36] A model based on identified property characteristics accommodates the hetrogeneous qualities of land. Using this model, Chicoine predicted prices for characteristics that differentiate land parcels from observations on land prices and associated characteristics. The value of urban fringe farmland is hypothesized to be a function of access to points of economic and social attraction, amenity and physical properties, the availability of public services and institutional factors that influence the land market and its participants. Variables selected included type of buyer and seller, improvements, location, soil properties, parcel size, land use and zoning classification.

The model was estimated using a sample of 491 farmland transactions collected from real estate transfer declarations during 1970-1974 for Will County, Illinois which is one of the six Chicago Standard Metropolitan Statistical Area counties. Uses of neighboring land were found to significantly impact urban fringe farmland prices.

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[36] David L. Chicoine, "Farmland Values at the Urban Fringe: An Analysis of Sale Prices," Land Economics , vol. 57, (1981), pp. 353-362.

The negative impact on land prices of neighboring water bodies or a stream, which may be a reflection of flood hazards or poor water quality, was not significant. Soil productivity's influence on farmland prices in the urban fringe appeared to be overshadowed by locational attributes of parcels. Statistically, the presence of buildings had no significant effect on price in the study market. Parcels fronting on local township roads sold for statistically significant lower prices than parcels fronting on roads maintained by other governmental units (county or state government). Price decreased as parcel size increased suggesting the presence of plattage value in the market. Statistically, there was sufficient price variation among parcel sizes to conclude that the size of tract does negatively affect value. The price of agricultural zoned farmland is statistically lower than the price of alternatively zoned land. The difference between the prices of residential and industrial/commercial zoned farmland is not significant. The coefficient of determination, R^2 = .52.

Summary

Adams, Clonts, Hurshak, Hurshak and Sadr, and Chicoine have concentrated on prediction of land prices in urban influenced areas where agricultural and urban forces interact and complicate the estimation and understanding of land prices. Table 2.1 presents a comparison of the

TABLE 2.1
COMPARISON OF UNDERLYING THEORETICAL CLASSIFICATION
OF LAND VALUE INDICATORS

THEORETICAL CLASSIFICATION	AUTHOR(S) OF STUDY				
	ADAMS et al.	CLONTS	HURSHAK	HURSHAK and SADR	CHICOINE
1. Physical Characteristics of the Site	Parcel Size	Parcel Size, Value of Improvements	Parcel Size	Parcel Size, Percent Building Value	Soil Productivity, Parcel Size
2. Accessibility Characteristics of the Site	Distance to City Center, Major Traffic Artery, Public Transportation	Distance to Urban Periphery, Urban Access Highway	Distance to Urban Center, Highway, Second City, Municipality	Distance to Urban Center, Highway, Second City, Municipality	Distance to Largest Urban Center, Next Largest Urban Center, Nearest Town, Freeway
3. Environmental Characteristics of Space Surrounding the Site	Environment Quality, Land Use	Frontage Road Condition, Sewer and Water Available, Land Use	Land Use, County Location (Geographic Quadrant)	Environment Quality, County Location, Land Use	Frontage Road Type, Land Use
4. Institutional Characteristics of the Site	Zoning Classification	Zoning Classification	Zoning Classification, Tax Rate	Zoning Classification, Tax Rate	Zoning Classification

underlying theoretical classification of land value indicators used by each of these researchers.

The general theoretical classification delineated in these studies categorizes land value indicators on four dimensions: physical characteristics of the site, accessibility characteristics of the site, environmental characteristics of the space surrounding the site and institutional characteristics of the site. This classification of factors that influence land prices will be used to identify and select appropriate variables for urban-rural fringe land price prediction and to develop a model of transaction prices for urban influenced land in Chapter III to follow.

Although, most studies reported acceptable R^2 values to measure the goodness of fit of the estimated regression model, the results were not validated to determine how well the technique performed to predict real property values. However, regression analysis has been used as a technique by many researchers who have demonstrated it to have applicability to standard residential appraisal, property tax assessment, valuation of apartment buildings and land valuation problems. Most of the empirical work reviewed emphasized the explanatory and conceptual nature of the models formulated and not the predictive quality of the results.

III. DEVELOPMENT OF A PREDICTIVE MODEL OF TRANSACTION PRICES FOR LAND IN THE URBAN-RURAL FRINGE

The review of theoretical and empirical literature in Chapter II delineated a number of factors that influence land prices. The purpose of this Chapter is to restate these factors in a mathematical form and to develop appropriate statistical methods to test the hypothesized relationships. Following is a discussion of characteristics of land and the land market, identification and selection of variables for land price prediction, a description of the proposed model and presentation of the research methodology and statistical estimation methods.

The model building procedure which is followed in this study is a modification of the research procedure recommended by Draper and Smith in which the model building process is divided into three phases as shown in Figure 3.1[37] The planning phase of the model building procedure was discussed in Chapter I. The survey of researchers' opinions was presented in Chapter II. The discussion of techniques used in the development phase of the model building process, the functional form the model and statistical estimation methods are presented in this Chapter. Chapter IV discusses the application of the model to a specific study area. Finally, Chapter V presents the analysis and results of model testing and validation.

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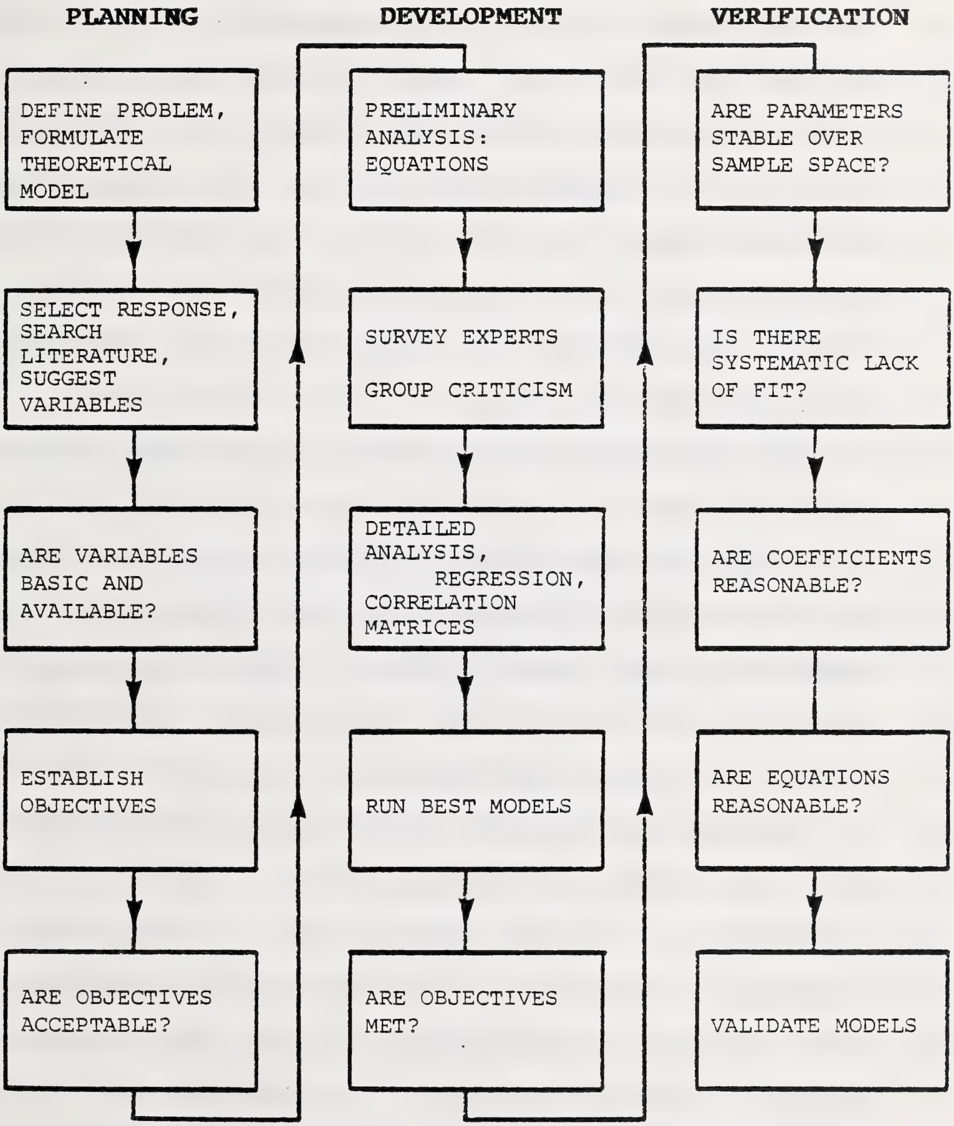
[37] Norman R. Draper and Harry Smith, Applied Regression Analysis, (New York: Wiley, 2nd ed. 1981), pp. 414-415.

FIGURE 3.1
MODEL CONSTRUCTION PROCEDURE


PLANNING
DEVELOPMENT
VERIFICATION
DEFINE PROBLEM, FORMULATE THEORETICAL MODEL
SELECT RESPONSE, SEARCH LITERATURE, SUGGEST VARIABLES
ARE VARIABLES BASIC AND AVAILABLE?
ESTABLISH OBJECTIVES
ARE OBJECTIVES ACCEPTABLE?
PRELIMINARY ANALYSIS: EQUATIONS
SURVEY EXPERTS
GROUP CRITICISM
DETAILED ANALYSIS, REGRESSION, CORRELATION MATRICES
RUN BEST MODELS
ARE OBJECTIVES MET?
ARE PARAMETERS STABLE OVER SAMPLE SPACE?
IS THERE SYSTEMATIC LACK OF FIT?
ARE COEFFICIENTS REASONABLE?
ARE EQUATIONS REASONABLE?
VALIDATE MODELS

Source:

Procedure Followed in Model Construction as Modified from Norman R. Draper and Harry Smith, Applied Regression Analysis, New York, John Wiley and Sons, 2nd ed. 1981, p. 414.

A. Characteristics of Land and The Land Market

The estimation and understanding of land market prices is complicated by the unique characteristics and features of land and the land market. These complications are increased in urban-rural fringe areas by the interaction of forces from the urban market and the agricultural market for land. Land use planning controls and public taxation policies also influence the land market. The influence of these institutional policies may be substantial in urban-rural fringe areas.

The unique characteristics of land commonly noted are its heterogeneity, immobility, fixed stock and durability. In a spatial sense land is neither consumed nor produced. No two land parcels occupy the same geographical space. Therefore, each parcel enjoys a spatial monopoly. These characteristics make the estimation and understanding of land market prices relatively more complex.

Land market charactersitics related to the features of land also complicate understanding the level and variation in land prices. These characteristics include imperfect knowledge, infrequent transactions, and a localized market structure with limited numbers of buyers and sellers. The immobility of land results in localized markets. Land must be sold where it is located. This leads to potential restrictions on the number of competitors in the market.

Market participation can also be restricted by credit requirements generally associated with land purchases. The local market supply of land is limited further by non arms-length transfers and institutional ownership. Financial arrangements and institutional factors can inhibit market information by distorting observed prices or delaying the reporting of prices. In general, competitive participation is absent in the land market for (1) sales between members of a family, (2) intracompany transactions, (3) forced sales (4) adjoining owner's and sitting tenant's purchases, and (5) the sale of fractional interests.[38]

The interaction of market forces from the urban land market and the agricultural land market must be considered in the estimation of urban-rural fringe land market prices. A large portion of the land in urban-rural fringe area is in agricultural use. The expectation of converting this agricultural land to urban uses puts upward speculative pressure on prices and complicates the estimation and understanding of land market prices. In addition to expected gains from nonfarm use, fringe area agricultural land prices reflect buyers' subjective, weighted estimations of the present levels of expected gains associated with general price inflation, farm income, asset accumulation, and the non-monetary rewards of land ownership. The total of these latter gains provides a lower limit for land prices in the urban-rural fringe.

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[38] John M. Copes, "Reckoning with Imperfections in the Land Market", in The Assessment of Land Values, (Madison: The University of Wisconsin Press, 1970), p. 59.

Land prices are also impacted by land use planning controls and public taxation policies. Because of the expectations of land use change, the influence of land use and tax policies on the land market may be substantial in urban-rural fringe areas. Land use controls affect the allocation of land to various uses. Tax policies influence investor behavior as attempts are made to avoid or reduce tax liability. These changes in behavior are reflected in land prices. Property tax liability will be capitalized into lower land prices while favourable income tax treatment of capital gains income will be capitalized into higher land prices.

B. Identification and Selection of Variables for Land Price Prediction

The purpose of the review of literature presented in Chapter II was to identify the theoretical and empirical basis for the selection of variables as indicators of land transaction prices. Due to data limitations and problems in model specification, it is impossible to include all of the variables that affect land price. The problem became one of how best to select a limited number of variables and relationships for testing. The set of criteria which were utilized in selecting a suitable set of variables were the following:

1. High expected association between dependent and independent variables.

2. Adaptability as predictors (quantifiable, stable, and observable).
3. Applicability to a broad range of locations and location decisions.
4. Sufficient spatial distribution of sample observations over the urban region.

The Dependent Variable

Market price of land is established through actual land transactions and is expected to reflect present and future net benefits to the landowner. The market-determined price of land gives a measure of its economic value. Price refers to the outcome of a specific transaction where a property is exchanged for a specific amount of money. Value on the other hand, is likely to differ from price in a non-perfect market. Buyers and sellers interact in the market to establish a transaction price largely on the basis of their subjective estimates of value. This study will incorporate estimates of price which are based on actual land transactions data.

Land price is represented by sales transfer prices for land based on "assurance fund" estimates required on all land transfers in Alberta. Assurance fund estimates do not necessarily reflect true-market prices but serve as approximations.[39]

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[39] The assurance fund estimates in use in Alberta to represent the value of land transferred are similar to the mandatory state stamps affixed to all transfers of title in the United States.

The basic data on land transfers are obtained from the Central Services Branch, Department of Municipal Affairs, in cooperation with Alberta Land Titles Offices. Real estate transfer prices are based upon "assurance fund"estimates required to be reported on all land transfers registered at Land Titles Offices. The estimates are indicated in Statement 4 of Form 39 of the Affidavit of Transferee (buyer or his agent), which is required under the Land Titles Act (1971).

Prices stated as "assurance fund" estimates are the primary records used and do not necessarily reflect the true market or real estate sales prices for the land under consideration. The true market price is approximated by assurance fund reports of actual transaction or sale prices of the property, as well as by assessment of the true market price when determined and vouched as such by the purchaser or his agent. Assurance fund estimates may be equated to "transaction price"; as the approximate price of the land for the purpose of the transaction. This study attempts to approximate market prices as closely as possible by the way of assurance fund estimates.

Assurance fund estimates do not include a separate breakdown for value of improvements and value of land. However, the majority of properties which will comprise the sample are expected to be relatively large in size and improvements are considered an essential part of value for agricultural purposes. The dependent variable selected was the price per acre of assurance fund land-transfer estimates which includes both the value of land and improvements.

Further support for the choice of assurance fund estimates as proxy measures to represent true market prices for land is offered by Burby, et al.[40]

> "Revenue stamps are a good indicator of true sales prices, with an average variation of less than five percent from actual market considerations. In addition, revenue stamps have an important theoretical advantage over assessed or appraised values as a source of land value data. That is, revenue stamps reflect the values which individuals place on property in the land market. Although these "values" may differ widely from the true economic value of property (because of market imperfections), they reflect decisions of different individuals about the value of real property relative to other possible investments. Assessed and appraised values, on the other hand, many simply reflect one individual's perceptions of what different types of property are worth and what factors contribute to property value."

The Independent Variables

Potential independent variables identified and selected to represent the characteristics hypothesized to influence land transaction prices were selected based on the following criteria:

1. Each variable must have a theoretical basis for selection as an indicator of land market price. The variables were selected based on the

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[40] Raymond J. Burby, et al., The Effects of Authorization for Water Impoundments on Shoreline Transition , Water Resources Research Institute, Center for Urban and Regional Studies, University of North Carolina, Chapel Hill, 1973, P.21.

theoretical and empirical review of literature.

2. Each variable must be readily visible and objectively measurable. Subjective measures and impressions of land market price indicators will not be considered due to their variation from one observer to the next.
3. All variables must be available in consistent published form or from convenient primary sources. This facilitates replication of the model in other geographic locations and alternative time frames.

Previous research indicates that characteristics such as agricultural productivity, distance to markets, types of roads, and parcel size influence agricultural land market prices. Urban land market prices have been found to be associated with distance to points of economic and social interest, investments in public services, topography, lot size, and amenities. Land market prices on the urban-rural fringe have also been found to be associated with similar urban oriented characteristics. They are also sensitive to agricultural characteristics. The relative importance of the characteristics should be related to that part of the fringe area land market within which a parcel is located. In addition to these characteristics, institutional characteristics and land market factors have also been associated with land market price variation.

A survey of land development and real estate investment companies in the Edmonton region was conducted as additional confirmation of the choice of variables for use in a predictive model of land transaction prices. Selected land investor/developers were asked to comment on the factors that were considered important in the selection and purchase of land for potential future development. The results of this survey are presented in Table 3.1, Summary Survey of Expert Opinion. These results generally confirm the factors that are considered to be important influences on land prices by previous researchers. The survey results are also particularly important for the selection of variables for a land price predictor model for applied use by practitioners who are active in the land market.

Factors selected to explain variation in land transaction prices are based on previous research and the summary survey of developer opinion and are grouped under physical characteristics of the site, accessibility to economic activities, environmental and location characteristics, institutional characteristics and land market factors. A description of each specific variable identified and selected for analysis in the model, including an evaluation of how well the variable meets the previously established selection criteria, follows.

(i) Physical Characteristics of the Site

Site characteristics were selected to represent site specific variables that are expected to influence the transaction price of land.

TABLE 3.1
SUMMARY OF EXPERT OPINION
SURVEYED APRIL, 1985

Company and Individual Surveyed	Theoretical Classification				Other Factors
	Physical Characteristics of the Site	Accessibility Characteristics of the Site	Environmental Characteristics of Space Surrounding the Site	Institutional Characteristics of the Site	
MELCOR DEVELOPMENTS Peter Daly		Road Pattern and Access	Time to Development, Available Utility Service	Annexation Potential	
CARMA DEVELOPMENTS Rudy Cope		Transportation Network and Access, Nearness to Employment and Shopping	Utility Services, Surrounding Land Use	Nearness to Similar Zoned Activities	Revenue Potential
GENSTAR Don Price	Current Inventory of Similar Land		Time to Development, Trend and Direction of Development		Rate of Return on Land, Holding Cost, Perceived Values
QUALICO Blane Usenik	Near Residential Land Use	Nearness to Employment, Transportation Availability and Cost	Utility Service Availability and Cost	Local Government Attitude, County Location	Cost to Develop

continued.....

TABLE 3.1 (continued):

Company and Individual Surveyed	Theoretical Classification				Other Factors
	Physical Characteristics of the Site	Accessibility Characteristics of the Site	Environmental Characteristics of Space Surrounding the Site	Institutional Characteristics of the Site	
WIMPY Bill Thulman	Soil Condition Agricultural Use	Transportation Network, Access to Employment Centers and City/ Satellite Towns	Nearness to Development, Utility Services		
NU WEST Al Skoreyko	Current Land Inventory	Transportation Access	Extent of Existing Development, Utility Service Availability and Cost	Future Use Zoning	Price, Rate of Return, Marketability, Subjective Intangeables
ALDRITT DEVELOPMENTS Doug Little	Soil Classification for Agriculture	Serviceability and Existing Infrastructure, Transportation Network	Extent of Existing Development, Future Potential	Anticipated Annexation	Price
BELVEDERE DEVELOPMENTS Les Sopervich	Near Developed Land Use	Available Utility Services	Proximity to Existing Development, in Development Path		Future Projected Value Income Potential

The size of a parcel of land has an influence on its value for its end use. If the site were to be retained for agricultural use a larger size has economic use benefits.[41] Larger farms are able to reduce unit costs by spreading overhead costs over greater acreage. Farm enlargement through land consolidation practice is an adjustment process to achieve optimal size. Economies of size are primarily promoted by technological advances in farm production which may be initiated by the adoption of labour saving equipment resulting in excess productive capacity of individual producers. Producers are able to bid more for land since marginal returns from additional land are greater than the average returns of the existing land base.

Chicoine describes the influence of size of parcel on the price of raw land.[42] If the size of parcels sold coincides with the size suited for the intended use, a proportional price-size relationship would exist. If land parcels are larger than required, the additional area adds little or nothing to the utility of the buyer. The costs of subdividing could result in a persistent declining marginal relationship between price and size, implying that less will be paid per acre for larger parcels. On the other hand, if transferred parcels are too small, and there is value in land assembly, more will be paid per acre for larger parcels. The incremental values for assembling land is commonly referred to as plottage while subdividing land is called plattage. It is possible for plottage and plattage value to coexist or for land value and size to be proportional in the urban-fringe farmland market.

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[41] Summary of a discussion on Farm Consolidation with Dr. R. Veehman, Department of Rural Economy, University of Alberta.

[42] David L. Chicoine, "Farmland Values at the Urban Fringe: An Analysis of Sale Prices," Land Economics, vol. 57, n. 3, (August 1981), pp. 354-355.

Land assessment was considered as a proxy variable to represent productivity of the land. Assessment practice dictates that the assessed value reflects the lands agricultural productivity and takes into account such measures as soil type, fertility, frost-free days, rainfall, hours of sunlight and other measures of the existing land use. However, due to differences in assessment practice, subjective opinions by different individual accessors and changes in general reassessment dates throughout the region, it was concluded that assessment values would not present an equitable opinion of value. In addition, the cost in time and money makes it impractical to search each individual property tax assessment record to match the data with the actual land transaction sampled.

Potential productivity of the land may be best represented by the Canada Land Inventory soil classification index. Canada Land Inventory classes for agriculture give an indication of the relationship between transactions and agricultural soil capability. The Canada

Land Inventory class definitions are as follows:[43]

CLASS:

1. Soils in this class have no significant limitations in use for crops;
2. Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices;
3. Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices;
4. Soils in this class have severe limitations that restrict the range of crops or require special conservation practices or both;
5. The severity of the limitations of these soils renders them unsuitable for annual cultivation. Class 5 soils may be improved for the production of perennial forages and pastures.
6. Soils in this class have some natural grazing potential, and improvement practices are not feasible;
7. Soils in this class have no capability for arable culture or permanent pastures;

The building value portion of total assurance fund value cannot be determined from land titles records. In addition, buildings are not assessed or taxed in Alberta on land that is used for agricultural purposes. Although building value would be a desirable variable for inclusion in this analysis it was rejected as nonquantifiable and impractical to collect.

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[43] Partially adapted from "Soil Capability for Agriculture in Alberta," L.K. Brocke, (Alberta Environment, May 1977).

Other site characteristics, as measures of development potential, were considered but also were rejected as nonquantifiable and impractical to collect. Site characteristics such as topography, scenic amenities, improvements and utility services did not meet previously established variable selection criteria and were not included in this analysis because of difficulty of collecting and categorizing such data.

(ii) Accessibility to Economic Activities

The theoretical literature and empirical studies reviewed have clearly established accessibility of the site, measured in distance from the Central Business District (CBD), as having a major influence on land market price. From Alonso's work it was concluded that the desire for accessibility to the urban center might be expected to result in continuous development extending out from that center, since people seek more accessible locations and are willing to pay more for them.

Most of the empirical research reviewed indicated that travel time rather than distance was a more accurate representation of site accessibility. They reasoned that travel time considered the costs associated with travel friction which included terminal time expenditure and frustration associated with traffic congestion. Although the studies recognized the importance of travel time they indicated that lack of data on travel time required them to use distance as a proxy measure instead.

However, Chapin specifically researched the influence of time-distance measures of accessibility.[44] He analyzed variations in the importance of accessibility to establish whether travel time was more significantly associated with land development than travel distance in the various mix of factors tested. He concluded, in his study of Greensboro, that there was no appreciable difference in simple or multiple correlation coefficients when time measures are substituted for distance.

Chicoine in his study of land prices surrounding Chicago indicated that although travel time may be the primary concern, distance measures supplemented by surface transportation distance should reasonably represent access.[45]

The variables to represent accessibility of the site to economic activities were therefore selected to conform to a multi-center environment and to reflect distance as an accurate measure of accessibility. Specifically, both straight line aerial and travel distances are to be measured from the site to the urban CBD, nearest satellite town CBD and city boundary. Travel distance only is measured to the nearest major highway and nearest regional shopping center. In all cases it is hypothesized that land market price will be negatively related to distance. In other words, the more accessible the site to the variables identified, the higher the price or the less accessible the lower the price.

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[44] Stuart F. Chapin, Jr. and Shirley F. Weiss, Factors Influencing Land Development, (Chapel Hill, North Carolina: Institute for Research in Social Science 1962), pp. 51-52.

[45] David L. Chicoine, "Farmland Values at the Urban Fringe: An Analysis of Sales Prices," Land Economics, vol. 57, (August, 1981), p. 254.

(iii) Environmental and Location Characteristics

In contrast to physical site characteristics, environmental and location amenities reflect off-site influences of artificial and natural conditions on land market prices. These influences have not been extensively treated by previous studies of urban-rural fringe land markets. Their impact depends on current or expected land use and the type of adjacent activity. The direction of the impact of environmental and location effects on fringe area land prices is uncertain. Therefore a number of variables representing environmental characteristics will be specified on an a priori basis and tested as to their significance in prediction of land transaction prices.

Current land use of the site and the surrounding area will be specified as a proxy measure of environmental quality and the homogeneity of surrounding uses. Measures of frontage road condition and provision of utility sevices are well known physical measures of environmental quality. Location within the designated metropolitan fringe and specification of the county location reflect geographical differences in value due to directional differences in land use practice, development potential, level of municipal services provided and regulatory influences. Population density, measured on a disaggregated township basis, will provide an additional measure of the intensity of environmental land use.

(iv) Institutional Characteristics

The previous factors largely represent economic forces in an urban influenced area. They are influenced by institutional policy decisions affecting the development of an urban influenced area over time. Zoning and tax policy variables are direct policy variables subject to change by political decisions and result in more uncertainty than the economic factors.

Zoning regulations take many forms. This study will measure the impact of use zoning on land prices. Other restrictive use or development policies such as designated restrictive development areas and airport related protection areas are also likely to affect land prices.

Generally, use zoning is expected to increase land prices as it changes from agriculture to residential to commercial or multi-family. However, the impact of zoning on a particular site also depends on the difficulty of changing the zoning and on other characteristics of the property. Variables will be specified to identify the effect on land price of zoning classification and restrictions on development.

Property tax is expected to have a negative but marginal effect on land prices. The property tax on land used for agricultural purposes is small compared to the expected gain in property value over time; especially in a growing urban area. The property tax mill rate in effect in the county where the site is located will be specified to measure the impact of property tax levels on land price and as a proxy measure to represent the quality of municipal services that may be expected at various taxation rates.

(v) Land Market Factors

To account for time series variation the dependent variable observations are coded as to the month of sale to create a time series variable commencing with the first month of the study period coded to equal one (January 1, 1971=1... December 31, 1982=144). Time was included as a continuous monthly variable to standardize parcel prices in real terms. To correct for changes in transaction prices due to inflation all prices will be expressed in terms of constant dollars by adjusting prices with the annual Canadian Consumer Price Index.

In addition, the prime interest rate in effect at the date of sale will be included as a proxy measure of the discount rate applied by the purchaser and to measure the effect of interest rate on the value over time. The prime interest rate in effect during the month of sale reflects financial conditions in the market at the time of property transfer. Data is obtained from the Bank of Canada Review which presents the historical Canadian Chartered Bank prime business loan rate. The prime business lending rate is the interest rate charged to the most credit-worthy borrowers on large business loans and is shown at month end. When there are differences in the rate charged by individual banks, the most typical rate is published.

Trippi indicated the utility of a time variable and an interest rate variable in the study of the use of regression in the prediction of home sale prices:

> "The time variable (year) compensates for long term inflation in property prices, and the current mortgage interest rate reflects the difficulty of obtaining new financing for the sale."

Interest rates are expected to be inversely correlated with sale price. However, he indicates some caution in the use of interest rates as variables when he concludes that large standard errors associated with the interest variable seem to rule out placing much emphasis on this variable for adjustment of sales price in the actual appraisal situation.[46]

Land market activity measures will be specified as an attempt to include indicators of land market supply and demand conditions. The total number of acres of land transferred and the average assurance fund estimate during the year of land transfer will be specified by county and year of sale. These measures should provide a reasonable proxy measure of land market activity.

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[46] R.R. Trippi, "A Comparison of Linear and Non Linear Models of Residential Real Property Value," The Appraisal Journal, (October 1974), p. 568.

Wendt, in his multiple regression analysis on land values and their determinants of six San Francisco Bay area cities, concluded that growth in total urban land values and site values generally paralleled the economic growth of individual cities. He noted that front-foot values of land in the central business district, as a measure of land value, coincided with economic growth.[47] In reference to the influence of a major urban concentration on land values Wendt states:

> "Although urban land values are undoubtedly responsive to broad changes in supply brought about by changing transportation developments, the latter appear to have been countered in greater or lesser degree by changes in demand associated with rising population and income and expanded urban services.[48]

Ruttan regressed value of farm land and buildings against irrigated cropland, non-irrigated pasture, and county population for 1939, 1949 and 1954. [49] His results indicated that variations in farm real estate values were positively associated with variations in population pressure. Correlations with the above variables explained 75 to 80 percent of total variation. However, population was significantly the most important variable in all years analyzed.

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[47] Paul F. Wendt "Economic Growth and Urban Land Values," The Appraisal Journal, (July, 1958), p. 436.

[48] Wendt, p. 442.

[49] V.W. Ruttan, "The Impact of Local Population Pressure on Farm Real Estate Values in California," Land Economics, vol. 37, n. 2, (May, 1961), pp. 125-131.

Population, population growth rates and population density calculations are selected to represent land market proxy measures of population pressure on land market prices.

Summary

Figure 3.2 summarizes a schematic description of the variables identified and selected for urban-rural land price prediction. The independent variables selected for use in model estimation are listed in summary form, along with the designated regression symbol and data source in Table 3.2.

C. Land Price Predictor Model

The Structure of Economic Models of Land Markets

No single specification of a model describing the land market has been widely accepted. The economic models for the proposed study are formulated largely through deductive reasoning, survey of investor/developer opinion, and the benefit of previous research. Models hypothesize the influence of various market forces on land prices. Economic

FIGURE 3.2
SCHEMATIC DESCRIPTION OF VARIABLES AND
RELATIONSHIPS STUDIED

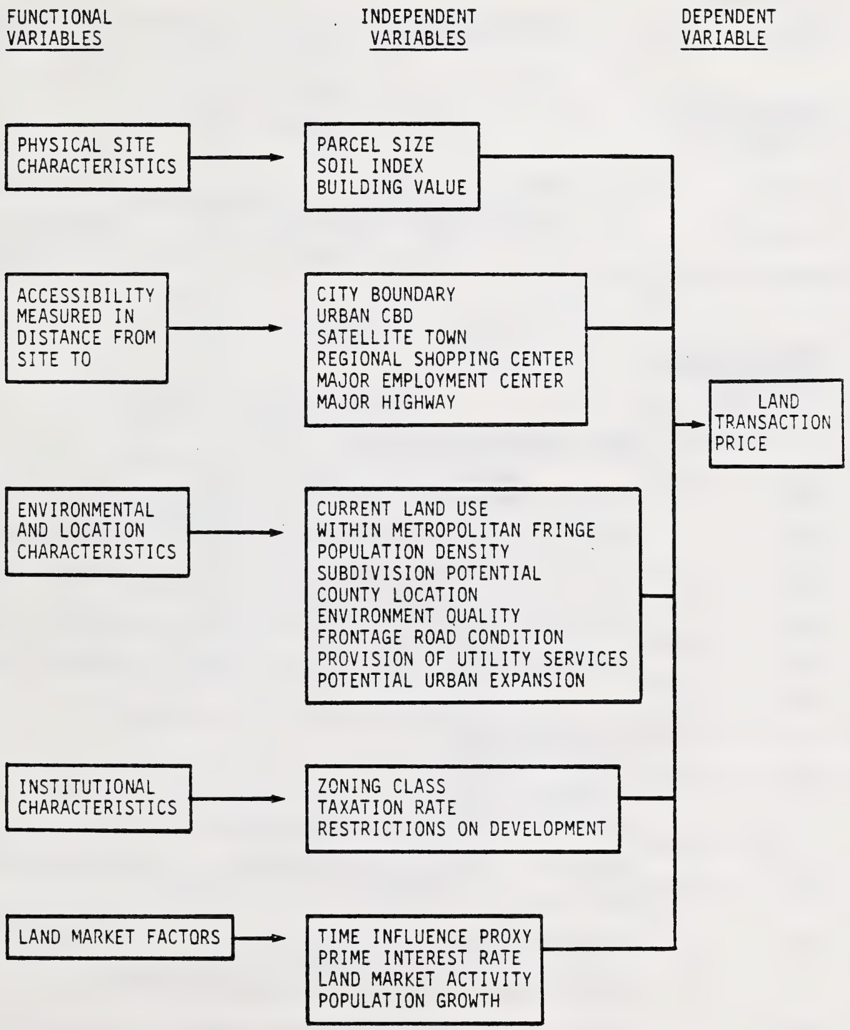
FUNCTIONAL VARIABLES
INDEPENDENT VARIABLES
DEPENDENT VARIABLE
PHYSICAL SITE CHARACTERISTICS
PARCEL SIZE
SOIL INDEX
BUILDING VALUE
ACCESSIBILITY MEASURED IN DISTANCE FROM SITE TO
CITY BOUNDARY
URBAN CBD
SATELLITE TOWN
REGIONAL SHOPPING CENTER
MAJOR EMPLOYMENT CENTER
MAJOR HIGHWAY
LAND TRANSACTION PRICE
ENVIRONMENTAL AND LOCATION CHARACTERISTICS
CURRENT LAND USE
WITHIN METROPOLITAN FRINGE
POPULATION DENSITY
SUBDIVISION POTENTIAL
COUNTY LOCATION
ENVIRONMENT QUALITY
FRONTAGE ROAD CONDITION
PROVISION OF UTILITY SERVICES
POTENTIAL URBAN EXPANSION
INSTITUTIONAL CHARACTERISTICS
ZONING CLASS
TAXATION RATE
RESTRICTIONS ON DEVELOPMENT
LAND MARKET FACTORS
TIME INFLUENCE PROXY
PRIME INTEREST RATE
LAND MARKET ACTIVITY
POPULATION GROWTH

TABLE 3.2
SUMMARY OF INDEPENDENT VARIABLES USED IN MODEL ESTIMATION

Regression Symbol	Description	Data Source
DEPENDENT VARIABLES:		
DOLLAR	Land Price Per Acre	Calculated
ADOLLAR	CPI Adjusted Land Price Per Acre	Calculated
SALE	Total Sale Price	Alberta Land Titles
INDEPENDENT VARIABLES:		
	SITE CHARACTERISTICS:	
SIZE	Size of Parcel	Alberta Land Titles
SOIL	Canada Land Inventory Soil Class	Alberta Agriculture
URES	Land Use Residential	Region Land Use Map
UCOM	Land Use Commercial/Industrial	Region Land Use Map
UAG	Land Use Agriculture (Base Case)	Region Land Use Map
	ACCESSIBILITY:	
SCBD	Measured Straight Line Aerial Distance to Edmonton CBD	Alberta Access Map
SBRY	Measured Straight Line Aerial Distance to Edmonton City Boundary	Alberta Access Map
SAT	Measured Straight Line Aerial Distance to Nearest Satellite Town CBD	Alberta Access Map
THWY	Travel Distance to Nearest Major Highway	Alberta Access Map
TCBD	Travel Distance to Edmonton CBD	Alberta Access Map
TBRY	Travel Distance to Edmonton City Boundary	Alberta Access Map

TABLE 3.2 (continued):

Regression Symbol	Description	Data Source
TSAT	Travel Distance to Nearest Satellite Town CBD	Alberta Access Map
TSC	Travel Distance to Nearest Regional Shopping Center	Alberta Access Map
	ENVIRONMENTAL CHARACTERISTICS:	
METRO	Location in Metro Fringe	Composite Regional Map
POP	Metropolitan Edmonton Population	Alberta Bureau Statistics
DPOP	Population Density in Township/Range	Alberta Bureau Statistics
SBDV	Measured Straight Line Aerial Distance to Nearest Approved Subdivision	Alberta Access Map
ASUB	Location Within One Mile of Nearest Approved Subdivision	Alberta Access Map
PARK	Location in County of Parkland	Alberta Access Map
LEDUC	Location in County of Leduc	Alberta Access Map
SCONA	Location in County of Strathcona	Alberta Access Map
STURG	Location in M.D. of Sturgeon (Base Case)	Alberta Access Map
ROAD	Frontage Road Conditions	Highway Maps
URBAN	Potential Urban Expansion	Composite Regional Map
	INSTITUTIONAL CHARACTERISTICS:	
ZRES	Zoned Residential/General Rural	Composite Regional Map
ZCOM	Zoned Commercial/Industrial	Composite Regional Map

TABLE 3.2 (continued):

Regression Symbol	Description	Data Source
ZAG	Zoned Agriculture (Base Case)	Composite Regional Map
TAXP	County Taxation Rate	County Tax Assessor
RDA	Location in Special Control Area	Composite Regional Map
	LAND MARKET FACTORS:	
TIME	Code to Represent Month of Sale (Jan. 1971 = 1...Dec. 1982 = 144)	
INTRT	Prime Interest Rate in Effect Month of Sale	Bank of Canada Review
CPI	Annual Consumer Price Index For Edmonton	Statistics Canada
GPOP	Population Growth Rate Edmonton Metro Region One Year Lagged	Census of Canada
TRANS	Acres Transferred by County, and Year of Sale	Alberta Agriculture
XVAL	Average Per Acre Price by County, and Year of Sale	Alberta Agriculture
NCR	Number of Country Residential Parcels Created by County and Year	Regional Planning Commission
ACR	Land Area Subdivided for Country Residential by County and Year	Regional Planning Commission
OPEC	Alberta Wellhead Oil Price for Month of Sale	Alberta Energy

theory provides knowledge concerning the nature of these economic forces. However, economic theory is not able to provide knowledge concerning the number of equations to be specified in a model of the land market or whether such equations are to be in a linear or non-linear form. As indicated by Koutsoyiannis , the complexity of the economic relationships, the purpose of the study and the availability of data are all considerations in determining the nature of the model.[50]

Single-equation models assume a monocausal relationship. When applied to a land market, the equilibrium price is assumed to be a function of a set of independent variables. Since many of the economic variables might be associated with both supply and demand relationships, single-equation models may not be efficient in describing the complexities of a particular market.

If a single-equation model is to include all the variations in land prices, market supply must be assumed to be predetermined. This assumption could be difficult to impose when seeking a realistic economic model. However, the limited ability of a single-equation model to describe the functioning of a market may be offset by the ability to generate estimates for most economic phenomenon. Furthermore, single-equation models may be the only feasible models when data is limited. Single equation models are also well suited to ordinary least squares (OLS) regression techniques for estimating coefficients.

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[50] A. Koutsoyiannis, Theory of Econometrics, (London: The MacMillian Press, 1981), p. 16.

Assuming that random components of each equation are independent, parameter estimates can be derived through ordinary least squares (OLS) procedures. However, in an empirical analysis the nature and use of models may be largely influenced by data availability.

Model Formulation Criteria

The focus of this research is on the application of quantitative methods to predict land price with emphasis on improving the predictive capability of the model. The following three requirements for the predictive model will be imposed:

1. The model must evolve out of a logical consistent framework, or theory.
2. The model must utilize constructs that correspond to measurable behavior or other phenomenon in the real world.
3. The model must be easily tested empirically.

The specific objective is to examine land market price under the influence of a major urban concentration. The purpose of this examination is to identify a model capable of predicting land transaction prices. Achievement of the following intermediate objectives are necessary to meet this purpose:

1. The determination of the relationship between changes in land prices and a set of objective

characteristics. This is to be accomplished by expressing the relationship in the form of the general linear model and testing the strength of the relationship using empirical data. Several forms of the model are tested.

2. A test of the stability of the relationship over time to determine the predictive capability of the model. This is to be tested by using the model to predict values of the dependent variable and comparing the results to actual values.
3. Selection of a model shown to be most successful for predictive purposes and the explanation of its use and limitations. The best performing model will be chosen with emphasis on reliability, problems of estimating values for the predictors and limitations to its use.

The Proposed Predictive Model of Urban-Rural Fringe Land Prices

A general model is specified in order to test the influence of economic forces which are hypothesized to affect land prices. Several equations are estimated from this general formulation.

At the aggregate level land prices are hypothesized to be a function of a series of economic variables. An economic model for this market would incorporate the market price of land in a relationship with a series of independent variables. This functional relationship is expressed in the following general form,

$$P = f(X_1, X_2, X_3 \ldots X_n)$$

in which the dependent variable, P, the market price per acre of land is a function of a series of independent variables hypothesized to have causal relationships with P.

A single-equation model is specified for the aggregate land market surrounding the City of Edmonton. Disaggregrated supply-oriented data, particularly on the quantity of land transferred are not available for sufficient years to be incorporated into a time series analysis. Therefore, this study formulates single-equation models to accommodate data on a relatively limited number of variables for the period covering 1971 to 1982.

A model is formulated to test those variables which are expected to influence land price. This model incorporates data measuring the characteristics of the variables which have been hypothesized to have influenced the price of actual land transfer sales. The empirical data is collected from numerous primary and secondary sources. The model can be estimated using ordinary least squares (OLS) regression techniques which are discussed in the next section on statistical estimation techniques. Multiple regression procedures explicitly acknowledge components that contribute to land market price determination and do so by means of a framework in which the contribution rates are objectively quantified.

The basic model is expressed as:

$$P_n = f\ (S_n, A_n, E_n, I_n, M_n, X_n)$$

where:

P_n = actual transfer price per acre of land.

S_n = a set of measures as indicators of physical site characteristics.

A_n = a set of accessibility measures of distance of the land parcel from centers of economic activity.

E_n = a set of measures as indicators of environmental characteristics surrounding the site

I_n = a set of variables to indicate institutional forces affecting the site.

M_n = a set of land market characteristics.

X_n = other characteristics; (topography, development potential, amenities) which could not be developed from the data sources available.

D. Research Methodology: Statistical Estimation Methods

Selected variables have been proposed as predictors of the variation in urban-rural fringe land prices over time. Furthermore, economic models have been formulated as a means of estimating the coefficients for these variables. This section describes the statistical estimation techniques, the statistical criteria and limitations that might be encountered in the empirical analysis and application to real estate modeling.

Multiple Regression Analysis

Ordinary least squares (OLS) regression techniques will be used to estimate coefficients for the models. This is done using a Statistical Package for the Social Sciences (SPSSX) econometric computer program.[51]

The OLS regression model specified in linear form is as follows:

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[51] Norman H. Nie, et al., Statistical Package for the Social Sciences, (New York: McGraw-Hill, 1983).

$$Y = a + b_1 X_1 + b_2 X_2 \ldots\ldots b_n X_n + U$$

Y is the dependent variable whose values the researcher desires to predict and the X's are the independent variables used to perform the prediction. The b's are the estimated coefficients of the independent variables used to form a weighted average of the set of independent variables. Least squares regression estimates the coefficients to minimize the square of the sum of the differences between the weighted average and actual values of Y, $((Y - Y')^2$, where Y' is the weighted average).

The coefficients (b's) can be used to predict cases beyond the sample used to estimate the model. They define the slope of the surface in the dimension created by each independent variable and the dependent variable. For example, b_1 represents the amount of expected change in Y for each unit change in X_1 when all other X's are held constant. It is assumed that the effect of each independent variable is additive. Therefore the sum of the weighted variables may be used to estimate the dependent variable.

The intercept term, a, is a further parameter of the functional relationship. It is the constant term and defines the point at which the surface intercepts the axis of the dependent variable (the Y intercept).

The random error term, U, accounts for the unexplained variation in the dependent variable. The variation in the dependent variable is explained in a functional relationship by explained and unexplained components. Unexplained variation exists in an economic function for numerous reasons. Since variation in an economic variable is explained by many forces, unexplained variation in the dependent variable is likely caused by the omission of explanatory variables. Futhermore, unexplained variation may result from errors due to aggregation, improper model specification, errors of measurement and the random nature of human response to economic forces.

By specifying the distribution of values for the error term, OLS is able to estimate the parameters of an economic model. Koutsoyiannis describes assumptions pertaining to the error term as well as the explanatory variables as follows:[52]

1. U is a random variable.
2. The mean value of U in any particular period is zero.
3. The variance of U is constant in each period.
4. The variable U has a normal distribution.
5. The random terms of different observations are independent.
6. U is independent of the explanatory variable.
7. The explanatory variables are measured without error.
8. The explanatory variables are not strongly

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[52] A. Koutsoyiannis, Theory of Econometrics, (London: The MacMillian Press Ltd., 1981), pp. 55-58.

correlated.

9. Aggregate variables have been correctly aggregated.
10. The relationship being estimated is unique.
11. The mathematical formulation is correct.

(i) Coefficient of Multiple Determination

The difference between the actual value of Y and the predicted value is termed the residual. The residual is assumed to be the result of random variation not controlled in the model. By assuming that this random variation is normally distributed with a mean of zero and a constant variance, a statistical evaluation of the goodness of fit of the modeled relationship may be made.

The smaller the sum of the squared residual terms ($(Y - Y')^2$) relative to total variation in the dependent variables, the better the goodness of fit. This comparison may be made by use of the coefficient of multiple determiniation, R^2.

$$R^2 = \frac{\Sigma(Y - \bar{Y}^2) - \Sigma(Y - Y')^2}{\Sigma(Y - Y')}$$

where:

Y = the dependent variable.

Y = the mean of the dependent variable.

Y' = the prediction of the dependent variable.

If all predicted values are exactly equal to the actual values, the sum of the residuals is zero and R^2 equals one. At the opposite extreme, if all variation is random, the sum of the squared residuals equals the sum of the squared differences and R^2 equals zero. Since the sum of the squared residuals can never exceed the total variation in the sample, R^2 must always be zero or greater.

As the number of variables included in the regression equation approaches the number of observations in the sample, R^2 approaches one (1.00) regardless of the goodness of fit. For example, if a bivariate relationship were estimated using only two observations, all estimated points must fall exactly on the regression line, since two points are necessary to define a straight line segment. Only when a third observation is included can there be any possibility for a residual to exist. Therefore, any regression equation may be improved (higher R^2) by merely adding an additional variable, even though that variable adds no additional predictive power. To compensate for this distortion, R^2 is adjusted to take into account the remaining degrees of freedom:

$$\text{adjusted } R^2 = 1 - (1 - R^2)\ ((n-1)/(n-k-1))$$

where:

n = the number of observations.

k = the number of independent variables.

A low value of R^2 indicates that much of the variation in the dependent variable is not accounted for in the equation. A low R^2 may be due to inappropriate independent variables or may indicate that the true relationship is not linear. In the latter case, transformations of the variables may be made to simulate non-linear relationships.

(ii) **Standard Error of the Estimate**

The regression coefficient, which expresses the degree of slope of the regression function, is an estimate of the regression function based on the total population. Another sample of that same population is likely to yield a different estimate of the true regression coefficient. It is therefore desirable to obtain the standard error of any regression coefficient. A standard error calculated from the sample will allow an assessment of its statistical significance and an estimate of the range of the true regression coefficient.

The standard error of the estimate is defined as:

$$Se = \sqrt{\frac{SSE}{n-k-1}}$$

where:

Se = standard error of the estimate.

SSE = the error sum of squares or the unexplained variation.

n = number of observations.

k = number of variables.

The standard error of the estimate is a measure of variability about the regression function and is the value of the error sum of squares divided by its degrees of freedom. Degrees of freedom refers to the number of observations that vary freely. Essentially these are the number of linearly independent observations used in calculating the sum of the squares of the deviations. Therefore, when adding an independent variable to an economic model, the degrees of freedom are reduced by one.

The standard error of the regression coefficient measures dispersion around the true parameter of the total population. Since errors are expected in the economic models, the size of the error determines whether the estimates are reliable. The standard error test indicates whether an estimated coefficient is significantly different from zero by comparing the standard error with the value of the coefficient. The null hypothesis suggests the true parameter is equal to zero. If the standard error is less than one-half the numerical value of the cofficient, the hypothesis is rejected. The standard error test thus implies that the variable is statistically significant and has an influence on the dependent variable. If the standard error exceeds one-half the numerical value, the hypothesis is accepted, which implies the variable has no influence on the dependent variable. The standard error test is a general rule providing a quick test for significance of estimated coefficients. However, the levels of significance of parameter estimates are also affected by the degrees of freedom. The t-test considers degrees of freedom and thus is a preferred measure of statistical significance in small sample sizes.

(iii) Tests of Signifcance

The F-Test

In multiple regression the most commonly held null hypothesis is that there is no linear regression at all in the population. All of the b values are equal to zero. If this hypothesis is true, then we would expect SSE, the error sum of squares, to be relatively large and SSR, the regression sum of squares, to be relatively small. If each of these sums is divided by its degrees of freedom a mean square is obtained. The appropriate statistic to test the null hypothesis is given by the ratio of the mean-square regression (MSR) to the mean-square error (MSE), which follows the F-distribution:

$$F = (SSR/k)/(SSE/(n-k-1)) = MSR/MSE$$

An F-test analyses variance as a means of determining the various factors causing variation in the dependent variable. The F-statistic is the ratio of any two independent estimates of variance and thus is used to test the hypothesis that all true parameters are zero. Since this hypothesis implies that the explanatory variables have no influence on the dependent variable, it tests for the overall significance of the regression equation. The F-statistic is also used in testing whether adding a new variable significantly improves the explanation on variation in the dependent variable.

The t-Test

To determine the significance of an individual coefficient, b, in the regression model, a test is used which is similar to the test for the slope in simple linear regression. The null hypothesis, $H\ \ : b = 0$, means that the variable has no linear relationship with Y, holding the effect of the other independent variables constant. Under the assumption that the error is normally distributed, the test for this null hypothesis follows the t-distribution. The determination of t in a practical application is done by forming the ratio of the coefficient to its estimated standard error. When the calculated t exceeds the critical value of t the null hypothesis of no significance can be rejected. It is then concluded that the variable does have an important influence on the dependent variable even after accounting for the influence of all other variables included in the model.

Standardized Regression Coefficients

The coefficients of regression (b) represent the amount of change in one of the independent variables, controlling for the effect of all others. Since the independent variables are expressed in different units and have different standard deviations, it is not possible to determine the relative importance of these variables by comparing their regression coefficients. Standardized regression coefficients are designed to permit such a comparison.

The standardized regression coefficients (betas) are formed by stating each of the variables in units of its own individual standard deviation or by formula:

$$B_{yx} = (b_{yx}(S_x))/S_y$$

where:

B_{yx} = beta coefficient for y and x.

b_{yx} = regression coefficient for y and x.

S_x = standard deviation of x.

S_y = standard of deviation of y.

Statistical Estimation Problems

The validity of the OLS estimates as well as the statistical criteria are influenced by the empirical data. Therefore, the statistical results of this study are evaluated with respect to econometric criteria that test for imperfections in the economic data. When the assumptions concerning the error term and the explanatory variables do not hold, the validity of the estimates and the statistical criteria become suspect. A common statistical problem that originates in the data is multicollinearity.

(i) Multicollinearity

OLS estimates assume that independent variables are not perfectly linearly correlated. A high level of correlation between two independent variables introduces the statistical problem of multicollinearity. The problem essentially is in obtaining precise estimates of the separate effects of independent variables that are highly correlated. The statistical criteria used to evaluate the reliability of the parameter estimates might also be influenced since intercorrelated independent variables may cause increased standard errors. The high standard errors, therefore, might cause independent variables to have reduced statistical significance.

Morton indicates that multicollinearity can have a strong effect on the size of the regression coefficients and can cause coefficients to have opposite signs from those they would have in the absence of the collinearity. In cases where there is a high degree of multicollinearity, the size and signs of the regression coefficients obtained may be affected as much by the relationships between and among the independent variables as by the relationships between the dependent variable and the independent variables. In effect, the analysis is measuring and reporting the wrong set(s) of relationships. The regression model obtained may contain coefficients that differ in size and sign from logic and market knowledge. High levels of multicollinearity will eliminate the probability of drawing meaningful and useful inferences from the model.[53]

If the focus of the research is on prediction, as is the case in this study, rather than on interpretation, then multicollinearity may not be a problem. Suppose that the combined fit for the regression equation is very good. If the observed linear realtionships among all the independent variables can be expected to remain true for a new set of observations, then the regression model should also result in a close fit for the new sample values even if multicollinearity is present.

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[53] T. Gregory Morton, "Factor Analysis, Multicollinearity, and Regression Appraisal Models", The Appraisal Journal, (October 1977), pp. 578-588.

Data Reduction and Variable Selection Techniques

Data obtained with respect to the land market are likely to be highly correlated due to the influence of economic growth on many of the explanatory variables. In addition, many of the independent variables specified in land value models demonstrate concurrent movement in the measurement of the characteristics that the variable was selected to describe.

Morton used factor analysis as a screening device to systematically reduce the problem of multicollinearity. His initial specification of the model included 27 variables to measure size, land use, environmental quality, physical condition, time, accessibility and location variables. Factor analysis was applied to reduce the initial 27 variables to 18 factors. A reduced model was specified so that no more than one variable from any factor was selected for inclusion in the regression model. The final model consisted of 12 variables which resulted in a reasonably high R^2 of .884.[54]

Factor analysis will be the first statistical procedure to be applied in this study with the objective of reducing redundancy among variables and to identify a smaller number of underlying factors. Factor analysis is a quantitative method that isolates the major statistical dimensions or factors in a data matrix. It reduces a larger number of variables, many of which may be highly correlated, into a smaller number of underlying factors. By isolating these major dimensions, factor analysis provides information that is useful in reducing redundancy among variables. To the extent that redundant, highly correlated variables are excluded, multicollinearity is reduced.

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[54] Morton, p. 586.

Factor analysis will be performed on all of the independent variables in the data set. Once each of the factors have been isolated each independent variable will be assigned to one of the factor groups. Each variable will be assigned to the factor upon which it has the largest absolute factor loading (i.e. the factor to which it was most correlated). This procedure will result in each variable being classified as belonging to only one factor group. Next, when regression analysis is performed only one variable assigned to each factor group will be allowed to enter the regression process. Therefore, a variable entering the regression analysis from one factor will preclude any other variable entering from that same factor.

Because only one variable per factor dimension could be entered, and because the variables on each factor tend to be highly correlated with each other, this procedure will systematically reduce the probability that highly correlated variables would be included in the final regression model. Variables will be allowed to continue entering the regression procedure as long as they were all on separate factors and as long as they all had a partial F-test significant at the 0.10 level. This procedure will produce a regression model in which each variable is both statistically significant and representative of a different dimension in the original data.[55]

Model Validation

Model validation involves the determination that the model will function as intended. It includes as a study of the regression coefficients to determine their stability and if their signs and magnitudes are reasonable. Validation includes an investigation of the model's prediction performance by evaluating the differences between predicted and actual transaction prices.

Montgomery and Peck outline three types of procedures useful for validating a regression model:[56]

1. Analysis of the model coefficients and predicted values including comparisons with prior experience, physical theory and other analytical models.
2. Collection of fresh data with which to investigate the model's predictive performance.
3. Data splitting; that is, setting aside some of the original data and using these

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[55] This discussion on the combined use of factor analysis and regression analysis was adapted from Morton, pp. 580-582.

[56] Douglas C. Montgomery and Elizabeth A. Peck, Introduction to Regression Analysis, Wiley, (New York: 1982), pp. 425-437.

observations to investigate the model's predictive performance.

The coefficients in the final regression model will be studied to determine if they are stable and if their signs and magnitudes are reasonable. Predicted values of the dependent variable can also provide a measure of model validity. The predictive capability of the model will be tested using the estimated model to predict transaction prices of the dependent variable and comparing the results to actual transaction prices.

The most effective method of validating a regression model with respect to its prediction performance is to collect fresh data and directly compare the model predictions against it. However, this method has been rejected in the current study due to the time, effort and cost of collecting, coding and verifying new data.

When the collection of new data for validation purposes is not possible, a suggested procedure is to split the available data into two parts, the estimation data and the prediction data. The estimation data is used to build the model and the prediction data is used to study the predictive ability of the model.

The PRESS statistic may be considered as a form of data splitting. To calculate PRESS an observation is deleted and the regression model is fitted to the remaining n-1 observations. The prediction error, the deleted residual, for the deleted observation is calculated. The

PRESS statistic is defined as the sum of the squares of the n deleted residuals.

Double cross-validation is a procedure in which the data are first split into estimation and prediction data sets. A model is developed from the estimation data and its performance investigated using the prediction data. Then the roles of the two data sets are reversed. The advantage of this procedure is that it provides two evaluations of model performance. The disadvantage is that there are now three models to choose from, the two developed via data splitting and the model fitted to all the data.

In addition to model validation the regression model is checked for adequacy. Adequacy checking includes residual analysis, testing for fit of the model to the data, and testing for violation of assumptions of normality and constant variance.

Residual Analysis

Model assumptions, such as linearity of the regression function, normality of the error term, and constant variance are examined for appropriateness of the model. Residual analysis forms the basis for this examination. A residual is defined as the difference between the actual value and the predicted value, or the error term. Residuals are assumed to be normal random variables with a mean of zero and a constant variance. Residual plots are used to detect model inadequacy.

To examine the normality assumption the residuals are plotted in comparison with the cumulative normal distribution and departures from normality are analyzed. The normality assumption may also be analyzed by examining a histogram of residuals in comparison with a normal distribution of residuals. Standardized residuals are also used in detecting departures from normality. If the errors are normally distributed, approximately 68 percent of the standardized residuals should fall within one standard deviation and approximately 95 percent of them should fall within two standard deviations. Substantial deviation from these limits indicates potential violation of the normality assumption.

Plots of residuals on predicted values of the dependent variable are useful to detect common types of model inadequacy. If the plot indicates that the residuals are contained in a horizontal band centered around zero, with no systematic tendency to be positive or negative, there are no obvious model defects. Plotting the residuals against the corresponding values of the independent variables should exhibit similar patterns. Examination of these plots is useful to check the assumptions of constant variance and normality. Variable transformations may be required to correct for model deficiencies.

E. Summary

The independent variables selected for use in model estimation were listed in summary form, including the designated regression symbol, in Table 3.2. Once included in the model, each variable must stand the statistical test of significance. Research methodology combining factor analysis and regression procedures, based on prescribed criteria for retention in the model, will be used to eliminate those variables which are weakly correlated to the dependent variable or are redundant to the other variables included.

A complete description of the study area and each of the variables, including data sources and variable measurement and calibration criteria, is presented in Chapter IV to follow.

IV. STUDY AREA DESCRIPTION AND DATA SOURCES

This Chapter presents a description of the study area and a description of each of the variables, including data sources and variable measurement and calibration criteria.

A. Study Area Description: Characteristics and Trends of the Region

The empirical locus of this study lies within the Edmonton Region Planning Area which consists of portions of the Counties of Leduc, Parkland and Strathcona and the Municipal District of Sturgeon. This area results in a geographic unit which is more representative than the Census Metropolitan Area (CMA) with respect to physical, economic and social interaction within the Edmonton urban area.[57]

The average radius from the City of Edmonton central business district is approximately 30 miles; a distance considered to be the maximum practicable commuting range. Therefore the boundaries for the Edmonton Region Planning

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[57] Census Metropolitan Area (CMA) refers to the main labour market area of an urbanized core (or continuously built-up area) having 100,000 or more population. CMA'S are comprised of (1) municipalities completely or partly inside the urbanized core; and (2) other municipalities if (a) at least 40% of the employed labour force living in the municipality works in the urbanized core, or (b) at least 25% of the employed labour force working in the municipality lives in the urbanized core. CMA'S are created by Statistics Canada and are usually known by the name of the urban area forming their urbanized core. Alberta has two CMA'S: Edmonton and Calgary. The Edmonton CMA includes Fort Saskatchewan St. Albert, Gibbons, Morinville, Bon Accord, Edmonton, Legal, Strathcona County No. 20, Sturgeon M.D. 90, Alexander Reserve No. 134 and Redwater.

Area were adopted as the limits of the study area. The selected boundaries are expected to demonstrate the sphere of influence of the major urban concentration on land prices contained therein. It is the commuter zone for people who rely on Edmonton for employment opportunities, shopping, education, cultural and social amenities.

Many of the communities and satellite towns within the study area have experienced accelerated growth in the study period, 1971-1982, as a result of their close proximity to Edmonton. A substantial portion of this growth has taken place in the most recent five-year period; although not all of it is attributable to out-migration from Edmonton. Families moving into the area are increasingly selecting a fringe community as an alternative to living within the corporate boundaries of the city; others are moving in from outlying rural districts.

The characteristics and trends of the study area region will be described in the sections to follow.[58]

Edmonton Metropolitan Planning Region

The Edmonton Metropolitan Regional Planning Commission has the responsibility to conduct regional land use planning in the area centered on Edmonton, the capital of Alberta, Figure 4.1. The Edmonton Metropolitan Planning

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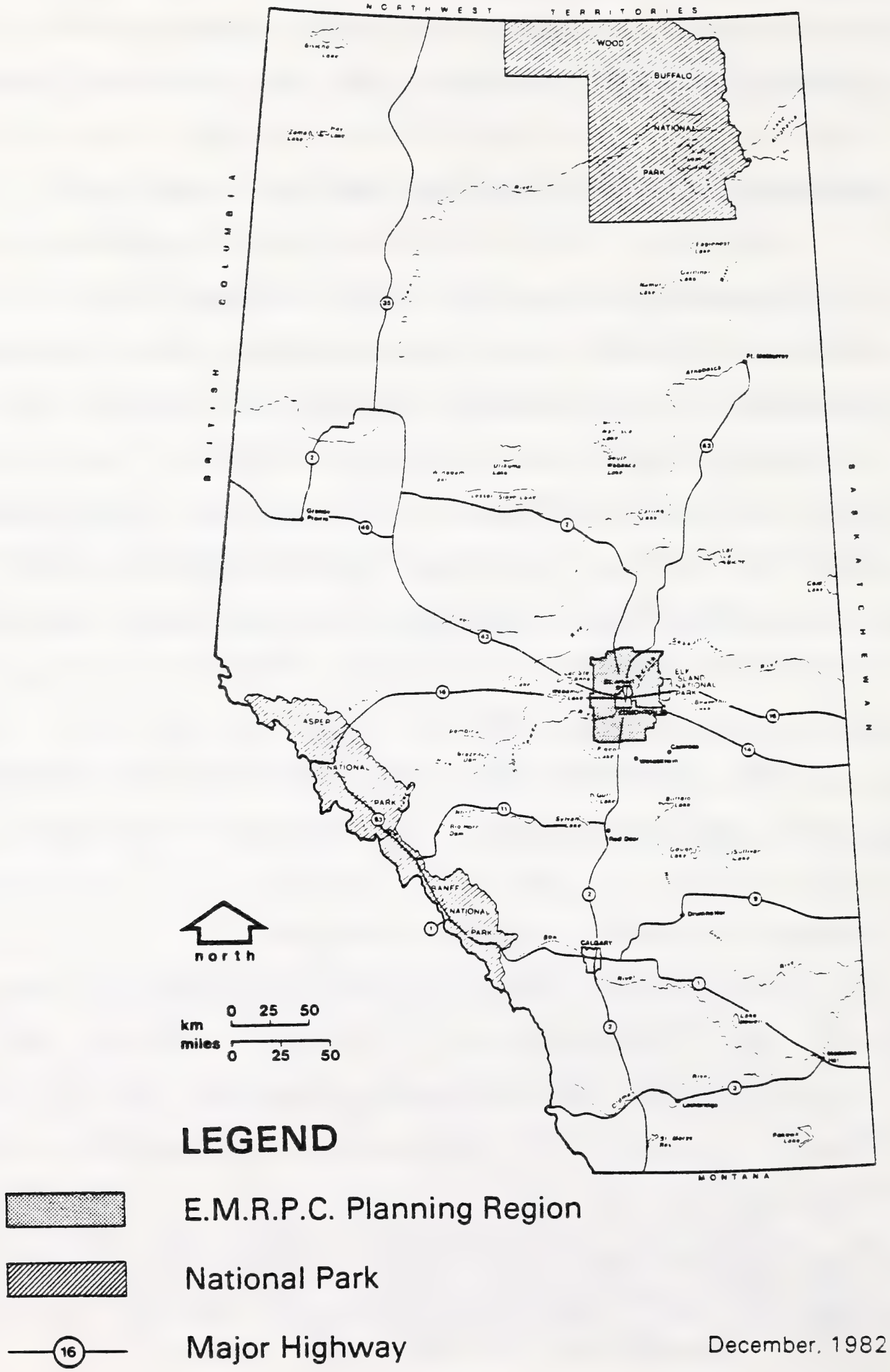
[58] Descriptive information is adapted from Edmonton Metropolitan Regional planning documents. Most of the information presented is found in "Edmonton Metropolitan Regional Plan", Edmonton Metropolitan Regional Planning Commission, adopted, September, 1983.

FIGURE 4.1
STUDY AREA LOCATION IN THE PROVINCE OF ALBERTA



NORTHWEST TERRITORIES
WOOD BUFFALO NATIONAL PARK
BRITISH COLUMBIA
SASKATCHEWAN
Ft. McMurray
Athabasca
Grande Prairie
ELK ISLAND NATIONAL PARK
EDMONTON
JASPER NATIONAL PARK
Red Deer
BANFF NATIONAL PARK
CALGARY
Drumheller
Medicine Hat
Lethbridge
MONTANA
north
km 0 25 50
miles 0 25 50
LEGEND
E.M.R.P.C. Planning Region
National Park
16 Major Highway
December, 1982

Region covers an area of approximately 2700 square miles as shown on Figure 4.2.

(i) Physical Characteristics and Resources

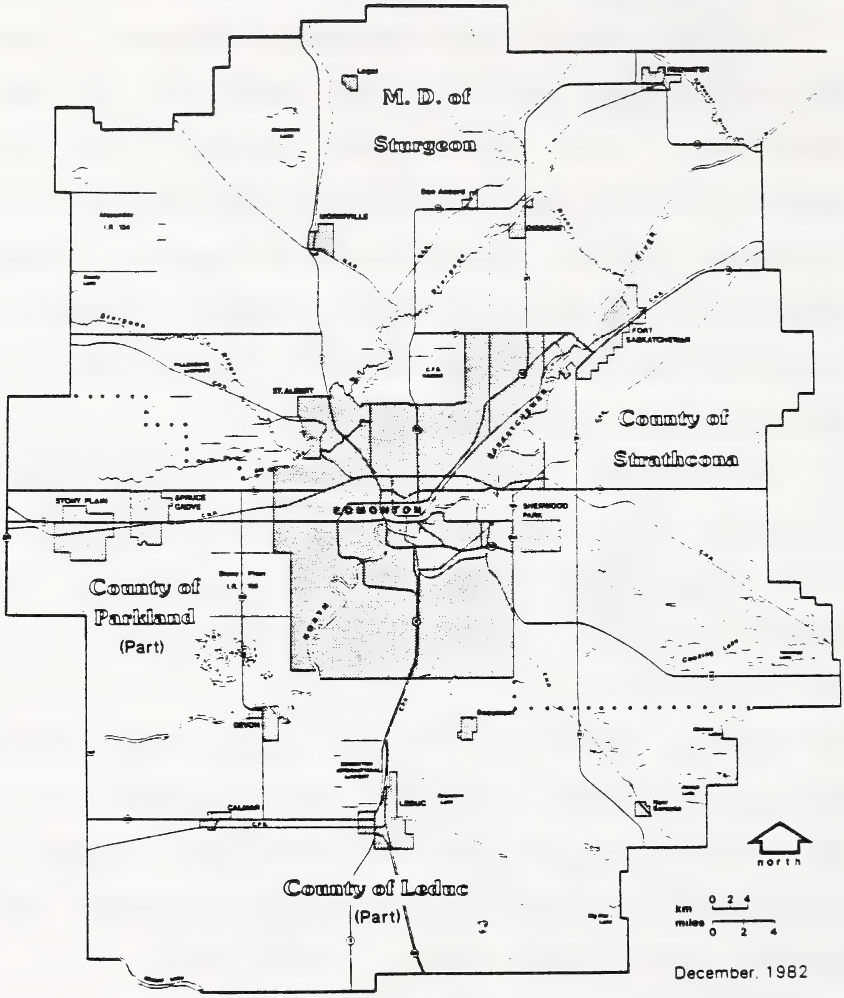
The most distinctive topographic feature, traversing the Region from southwest to northeast, is the North Saskatchewan River Valley. The Cooking Lake Moraine, located in the eastern portion of the Region, is another significant feature. Characterized by numerous ridges and depressions and the presence of a number of shallow lakes, including Cooking Lake. It contains the Region's largest area of natural tree cover.

The majority of the Region's soils are productive for agriculture and support a diversity of field and forage crops. Approximately 65 percent of the soils are rated as Class 1, 2, or 3, agricultural capability by the Canada Land Inventory.

Various fish and wildlife populations exist in the Region, with several habitat areas considered critical to the maintenance of rare or threatened species. These habitat areas are most often found in shoreland areas or areas of natural tree cover.

The water resources of the Region consist of streams, lakes and groundwater. The North Saskatchewan River is the major water supply source for most urban communities in the Region. Use of the smaller streams for water supply and sewage disposal is limited by low winter flows and poor

FIGURE 4.2
THE EDMONTON METROPOLITAN PLANNING REGION


M. D. of Sturgeon
Morinville
Redwater
Bon Accord
Gibbons
Fort Saskatchewan
St. Albert
County of Strathcona
Stony Plain
Spruce Grove
Edmonton
Sherwood Park
County of Parkland (Part)
Stony Plain I.R. 135
Devon
Calmar
Leduc
County of Leduc (Part)
Sturgeon
River
North Saskatchewan
C.N.R.
C.P.R.
north
km 0 2 4
miles 0 2 4

December, 1982

natural water quality.

The geological formations of the Region are a source of valuable natural resources, in particular, conventional oil, natural gas and coal deposits. Major deposits of sand and gravel are found in the Region, with those to the north and west of Edmonton valued for their yield of concrete-grade aggregates.

The diversity of the resource base and the natural environment has been, and will continue to be, a catalyst to development within the Edmonton Region.

(ii) Economic Trends

The discovery of oil near Leduc in 1947 marked the turning point in the Region's development and resulted in diversification of the resource-based economic activity, expansion of the service role of Edmonton, and the stimulation of population growth in nearby communities. The Edmonton Metropolitan Region became the center of operations for Alberta's petroleum industry and experienced a substantial influx of capital investment and skilled labour. By the mid-1950's the area had become the major petroleum refining and production center in western Canada. While the Region continues to maintain its agricultural base, the metropolitan area has developed further to become the transportation and distribution focal point for the rest of Alberta and Canada's north.

Currently the Edmonton Metropolitan Region is a dominant industrial, financial and institutional center for Western Canada. Although the Region has maintained the production and processing of natural resources, as its primary economic base, strong manufacturing, commercial, industrial, financial and institutional functions characterize its mature regional economy.

(iii) Population Trends

The Region has experienced marked changes in population growth and distribution during the past two decades. Since 1961, the regional population has nearly doubled to its 1981 level of 715,000, representing about one third of Alberta's total population. The population of the study area increased by 40 percent during the study period, from 520,000 in 1971 to 728,000 in 1982.

This rapid rate of growth has been accompanied by shifts in the distribution of people. In the early 1960's a trend to population decentralization began, with a dispersal of population growth to communities outside Edmonton. As a result, the proportion of the regional population living in the urban centers outside Edmonton has more than tripled since 1961. After a general decline, the rural population has increased, primarily as a result of rural residential development, and now constitutes about 8 percent of the Metropolitan Region's population.

Table 4.1 presents a population history for the region for the period 1971 to 1982. Table 4.2 details the percentage distribution of population between metropolitan, urban and rural areas of the region and Table 4.3 shows the percentage change in population for the period 1971 to 1982.

(iv) Regional Pattern of Development

The Region consists of a compact metropolitan-urban structure dominated by the City of Edmonton. Edmonton is the primary location of employment, and major social, cultural, educational and institutional facilities. Numerous smaller urban communities are also located within the Region. While these offer varying degrees of services to their residents and the surrounding rural areas, each has convenient access to the higher order services available in the central city. Transportation services and facilities contained in the Region focus on Edmonton and provide linkages with other parts of Alberta, Canada and beyond.

From the standpoint of their spatial characteristics, Canadian prairie cities are somewhat distinct. Unlike the older and more densely populated areas of Canada, the United States, and Europe, they tend to possess well defined boundaries. Residential overspills in prairie cities have gravitated towards pre-existent rural communities that lie within commuting range rather than to

TABLE 4.1
POPULATION OF THE EDMONTON METROPOLITAN PLANNING REGION AND MUNICIPALITIES, 1971-1982

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Alberta	1,627,875	1,657,300(e)	1,689,500(e)	1,722,400(e)	1,778,300(e)	1,838,037	1,911,400(e)	1,984,100(e)	2,058,700(e)	2,142,600(e)	2,237,724	2,315,100(e)
Edmonton CMA [2]	496,597	509,855	516,587	527,758	539,409	555,372	571,270	583,026	600,802	622,171	656,663	669,180
Edmonton Metropolitan Region [3]	519,698	536,091	546,017	560,334	576,094	596,022	614,420	632,631	651,561	676,820	716,101	727,803
Inner Metropolitan Area												
Edmonton City	438,155	441,530	442,365	445,691	451,635	461,361	471,474	478,066	491,359	505,773	532,246	551,314
St. Albert	11,800	12,637	15,088	19,418	21,343	24,129	25,543	27,408	28,718	29,512	31,996	32,982
Sherwood Park	14,282	19,273(e)	22,979(e)	24,969(e)	26,166	26,534	26,500(e)	26,500(e)	26,496	28,210(e)	29,285(e)	28,798(e)
TOTAL	464,237	473,440	480,432	490,078	499,144	512,024	523,517	531,974	546,573	563,495	593,527	613,094
Outer Metropolitan Area												
- Urban Total [4]	21,540	24,207	27,164	30,326	34,425	37,689	40,953	45,207	49,181	53,844	59,011	61,400
Outer Metropolitan Area												
-Rural Total	34,258	38,444	38,421	39,930	42,525	46,309	49,950	53,450	55,807	59,481	63,563	53,309

NOTES

1. e - estimate
2. Edmonton Census Metropolitan Area (CMA) includes Edmonton City, the County of Strathcona and the Municipal District of Sturgeon.
3. Figures for 1971 and 1976 are derived from the Census of Canada. Figures for non-census years have been derived from municipal census data or are estimates.
4. Includes: Beaumont, Bon Accord, Calmar, Devon, Fort Saskatchewan, Gibbons, Leduc, Legal, Morinville, New Sarepta, Redwater, Spruce Grove and Stony Plain.

TABLE 4.2
PERCENTAGE DISTRIBUTION OF POPULATION: METROPOLITAN, URBAN, RURAL, EDMONTON PLANNING REGION AND MUNICIPALITIES, 1971 - 1982*

	REGION		PROVINCE	
	1971	1982	1971	1982
Alberta	-	-	100.0	100.0
Edmonton Metro Region	100.0	100.0	31.9	31.6
Inner Metro Area	89.3	84.2	28.5	26.5
Outer Metro Area (Urban)	4.1	8.4	1.3	2.6
Outer Metro Area (Rural)	6.7	7.3	2.1	2.3

TABLE 4.3
PERCENTAGE CHANGE IN POPULATION: METROPOLITAN, URBAN, RURAL, EDMONTON REGION AND MUNICIPALITIES, 1971-1982*

	1971-1982
Alberta	42.2
Edmonton Metro Region	40.0
Inner Metro Area	32.1
Outer Metro Area (Urban)	190.5
Outer Metro Area (Rural)	56.8

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* Percentages based on data contained in Table 4.1.

'new' towns and suburbs outside metropolitan corporate boundaries.

The rural population is concentrated in country residential subdivisions, and in hamlets throughout the Region. The largest nodes of country residential development are found in the County of Strathcona, southeast of Sherwood Park and in the County of Parkland near Devon and north of Stony Plain. Other concentrations include those in the Looma district southeast of Edmonton, in the County of Leduc, and that to the northeast of St. Albert in the Municipal District of Sturgeon.

Resource extraction activities occur throughout the Region. Sand and gravel deposits are generally found in proximity to the major urban areas. The majority of the oil and gas wells and processing plants are located in areas near Redwater, Leduc, Devon and north of St. Albert. Major pipelines extend into the large refinery and petrochemical developments in the Fort Saskatchewan, Edmonton and Redwater areas.

(v) Planning Process and Land Use Regulations

Regional planning is the broadest level of land use planning in Alberta.[59] Regional planning commissions are formed by regulation of the Provincial Cabinet through the

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[59] Descriptive information on the planning process and land use regultaions is adapted from the publication Planning in Alberta: A Guide and Directory, Planning Services Division, Alberta Municipal Affairs, Edmonton, 1980.

Planning Act and encompass areas of land containing several municipalities that are functionally related through topographical, economic and/or transportation linkages. Membership in a regional planning commission is comprised of representatives from the region's municipal councils. In areas where no regional planning commission exists, the Planning Services Division of the Department of Municipal Affairs functions as the planning authority, acting on behalf of the Minister.

Membership in the Edmonton Metropolitan Regional Planning Commission totals 27 members with representation consisting of 9 members from the City of Edmonton, 2 members from the City of St. Albert and one member from each of the following: County of Strathcona, County of Leduc, County of Parkland, Municipal District of Sturgeon, Hamlet of Sherwood Park and the Towns of Fort Saskatchewan, Bon Accord, Devon, Calmar, Gibbons, Leduc, Morinville, Redwater, Spruce Grove, Stony Plain and Beaumont.

The Planning Act assigns subdivision approving authority for much of Alberta to the regional planning commissions. However, the regional planning commission's most important function is to prepare a regional plan.

A regional plan is the primary means of regulating major development in Alberta. In many cases, such as large increases in country residential development or the establishment of a major petrochemical operation, the effects of development may be felt in several municipalities and could be beyond the capability of a single municipality to control. By establishing regional goals and implementing supportive policies, development can be encouraged to occur where the most beneficial results can be obtained.

In a regional plan, the region may be divided into various land use classes such as agriculture, industry or urban, according to the goals and objectives of the plan and the suitability of the land for a particular type of development. Factors considered when assigning land use classes include the physical environment of an area, natural resources, present land use, population growth or decline, potential areas of land use conflict and demand by different types of development for new land.

A regional plan is also important in establishing a framework within which local municipal planning can occur. In the Planning Act it is mandatory that every statutory plan, replotting scheme, or land use bylaw of a municipality be in conformity with the regional plan affecting that municipality.

A general municipal plan is the primary planning document used at the municipal level in Alberta. Its principal function is to foster orderly and efficient land use development in a municipality. The general municipal plan takes the broad policies and programs contained in an area's regional plan and develops them in greater detail for application at the municipal level. The general municipal plan is largely concerned with the physical development of a community and therefore considers such matters as the location of different types of land use, the direction of future growth, the design of the transportation network and the level and location of utility servicing.

The land use bylaw is used to regulate the size and use of land and buildings within a municipality. Through careful enforcement of a land use bylaw, many goals and policies contained in a general municipal plan can be implemented and land use conflicts can be reduced. In a land use bylaw, the municipality is divided into a number of districts, within which are designated, permitted and conditional uses of land and buildings. The bylaws may also establish provisions, in general or for any specific district, that pertain to such matters as: minimum and maximum lot areas, floor areas of buildings, building set back from property lines, location of fences, off-street parking, billboard placement, density of population, and other matters specified in the Planning Act.

Subdivision of land in Alberta is governed by the Planning Act and the Subdivision Regulation. Subdivision, in general, means the division of a parcel of land for the purpose of obtaining separate title to part of the original parcel. This splitting of land into smaller pieces or lots is an intergral part of the land development process and an important tool for the implementation of statutory plan policies. A formal application for subdivision of land must be made to the planning authority having jurisdiction in the area. This may be a municipal planning commission, a regional planning commission, or the Planning Services Division of Alberta Municipal Affairs for areas not organized into commissions. A review of the subdivision application is conducted by the local planning authority to ensure that the land is suited for the proposed development and that the development does not conflict with existing plans for the area. Items reviewed include: topography, soil erosion, accessibility to public roadways, compatibility, and adequacy of a water supply and sewage disposal system.

B. The Data

This section describes data sources, data measurement techniques, data limitations and methods of constructing the variables. Both primary and secondary sources of data are used in model calibration. Problems of a methodological nature which have their origins in the data are also discussed in this section. Interpretation of regression coefficients is predicated on the definition of each variable and the scale of measurement of the variable. The definition, scale of measurement and source of each variable specified in the model follows:

1. Land Price Per Acre: This dependent variable is calculated by dividing the actual assurance fund

estimate by the total area of the parcel transferred in acres. Land price per acre will be inflation adjusted to constant dollars by application of the annual Canadian Consumer Price Index. The transfer prices presented are those prices registered by buyers and sellers in the Land Titles Offices. Land and building values were not separated in the original data. The basic data on all land transfers were obtained from the Central Services Branch, Department of Municipal Affairs, in cooperation with Alberta Land Titles Offices. Real estate transfer prices are based upon "assurance fund" estimates required to be reported on all land transfers registered at Land Titles Offices and legally described by Section - Township - Range - Meridian. The estimates are indicated in Statement 4 of Form 39 of the Affidavit of Transferee (buyer or his agent), which is required under the Land Titles Act (1971).

Prices stated as "assurance fund" estimates are the primary records used and do not necessarily reflect the true market or real estate sales prices for the land under consideration. The true market price is approximated by assurance fund reports of actual transaction or sale prices of the property, as well as by assessment of the true market price when determined and vouched as such by the purchaser or his agent. Assurance fund estimates may be equated to "transaction price", as the approximate price of the land for the purpose of the transaction. This study attempts to approximate market prices as closely as possible by the way of the assurance fund estimates. Therefore, estate transfers to executors and transfers of provincial crown lands, which usually understate the value, have been excluded. Land titles data abstracted includes the legal description, the total number of acres transferred, the total assurance fund estimate, month and year of title transfer.

The sample selection area was delineated to include only those land transfers in the Edmonton region which were legally described by Section - Township - Range - Meridian. By definition the Edmonton region is inclusive of Townships 48 to 58 and Range 20, west of the 4th Meridian to Range 1, west of 5th Meridian. A ten percent sample for each year of the study period will be randomly selected from all land transfers for parcels of greater than or equal to ten acres within the defined Edmonton region.

The initial sample will be modified to eliminate transactions which did not represent an unencumbered market price for raw land. All transactions of $1000. or less in assurance fund estimate will be excluded on the assumption that the nominal reported price represents a non arms-length exchange between related individuals or to settle estates.

Parcels of less than ten acres will be excluded by definition to be classified as "country residential" and therefore considered as urban raw land. A visual inspection of per acre prices will eliminate extreme low and high observations considered to be uncharacteristic of the raw land market. Observations located within city or satellite town corporate limits as of the transaction date will also be excluded. The final exclusion will be for incomplete data within each observation consisting of unspecified transfer value, missing size of parcel or incomplete legal description which will prevent property location and the measurement of assessibility variables and physical, environmental and institutional characteristics.

2. Size of Parcel in Acres: The size of the parcel in acres is provided as part of the primary Land Titles search data. Input of parcel size is to the nearest whole acre.

3. Canada Land Inventory Soil Class: Canada Land Inventory soil classification represents the relationship between transactions and soil capability. Soil classification data is obtained from Alberta Agriculture, based on soil survey information, and is recorded by legal description for each transaction sampled.

4. Land Use: Current land use in effect at the time of sale is classified in three basic land use categories: residential, commercial/industrial and agricultural. Land use is obtained by examination of Generalized Land Use Maps prepared by the Edmonton Regional Planning Commission. Data is coded by dummy variable representing land use in effect at the time of sale. (Code 1=YES, 0=NO for each land use classification).

5. Measured Straight Line Aerial Distance to Edmonton CBD: The locus of each actual land transaction will be plotted on the Province of Alberta Access Map, Topography Edition, Scale 1-250,000, from land titles legal description for each sample observation. The access map will become the base map from which all accessibility distance measures will be calibrated. The actual distance measurement will be the shortest straight line

aerial distance, in one-half mile increments, from the property boundary to the Edmonton CBD.

6. Measured Straight Line Aerial Distance to Edmonton City Boundary: Using the access base map, with the property locus plotted, the measured straight line aerial distance will be the shortest straight line distance, in one-half mile increments, from the property boundary to the city boundary. City of Edmonton boundary adjustments are made to conform to the date of sale. Annexation history for the City for Edmonton is presented in Figure 4.3.

7. Measured Straight Line Aerial Distance to Nearest Satellite Town CBD: Using the access base map, with the property locus plotted, the measured straight line aerial distance will be the shortest straight line aerial distance, in one-half mile increments, from the property boundary to the nearest Satellite Town CBD. Figure 4.4 illustrates the general spatial structure of the Edmonton metropolitan region including the designation of satellite towns.

8. Travel Distance to Nearest Major Highway: Using the access base map, with the property locus plotted, travel distance by road is measured, in

FIGURE 4.3
CITY OF EDMONTON ANNEXATION HISTORY MAP

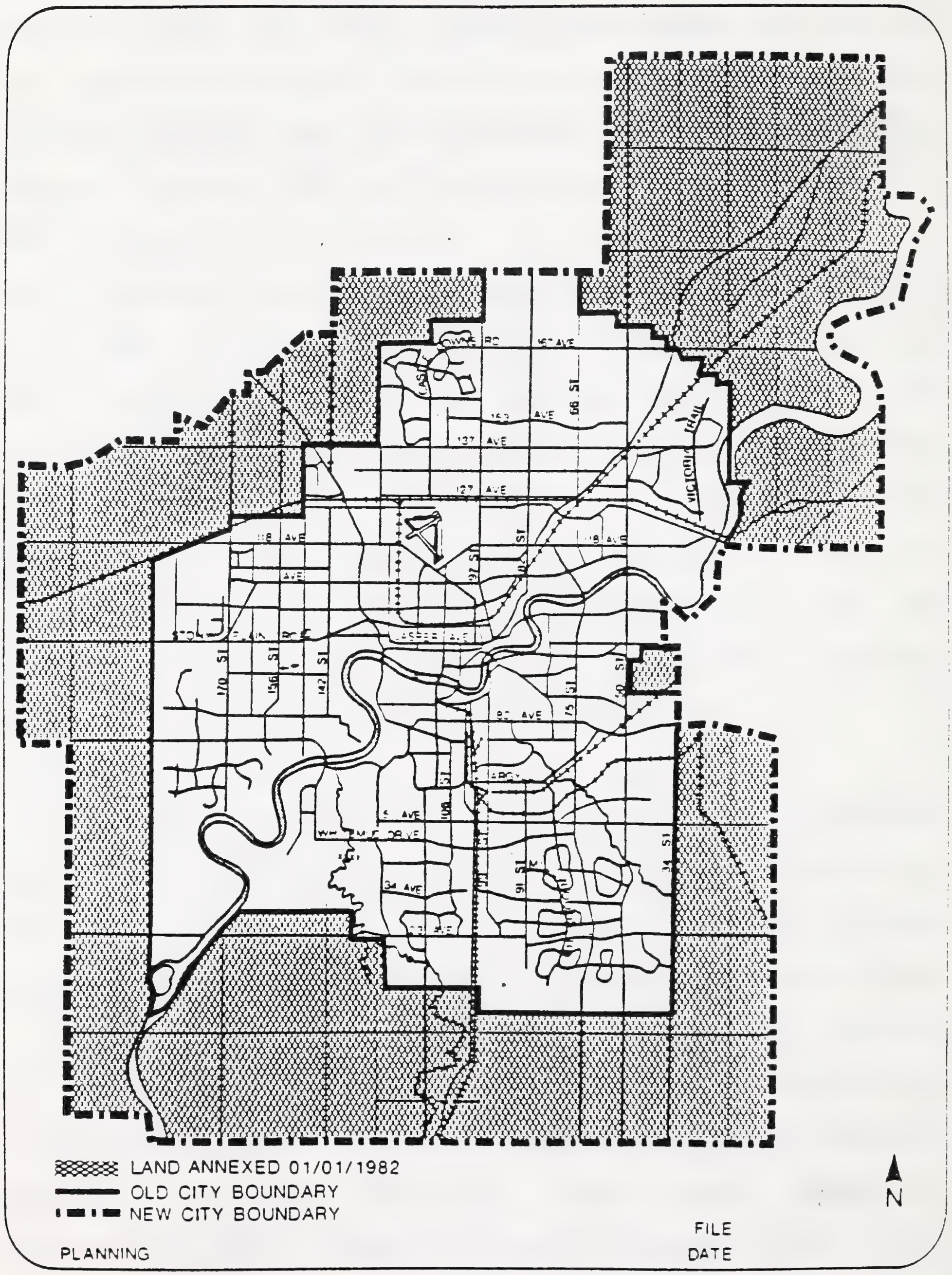
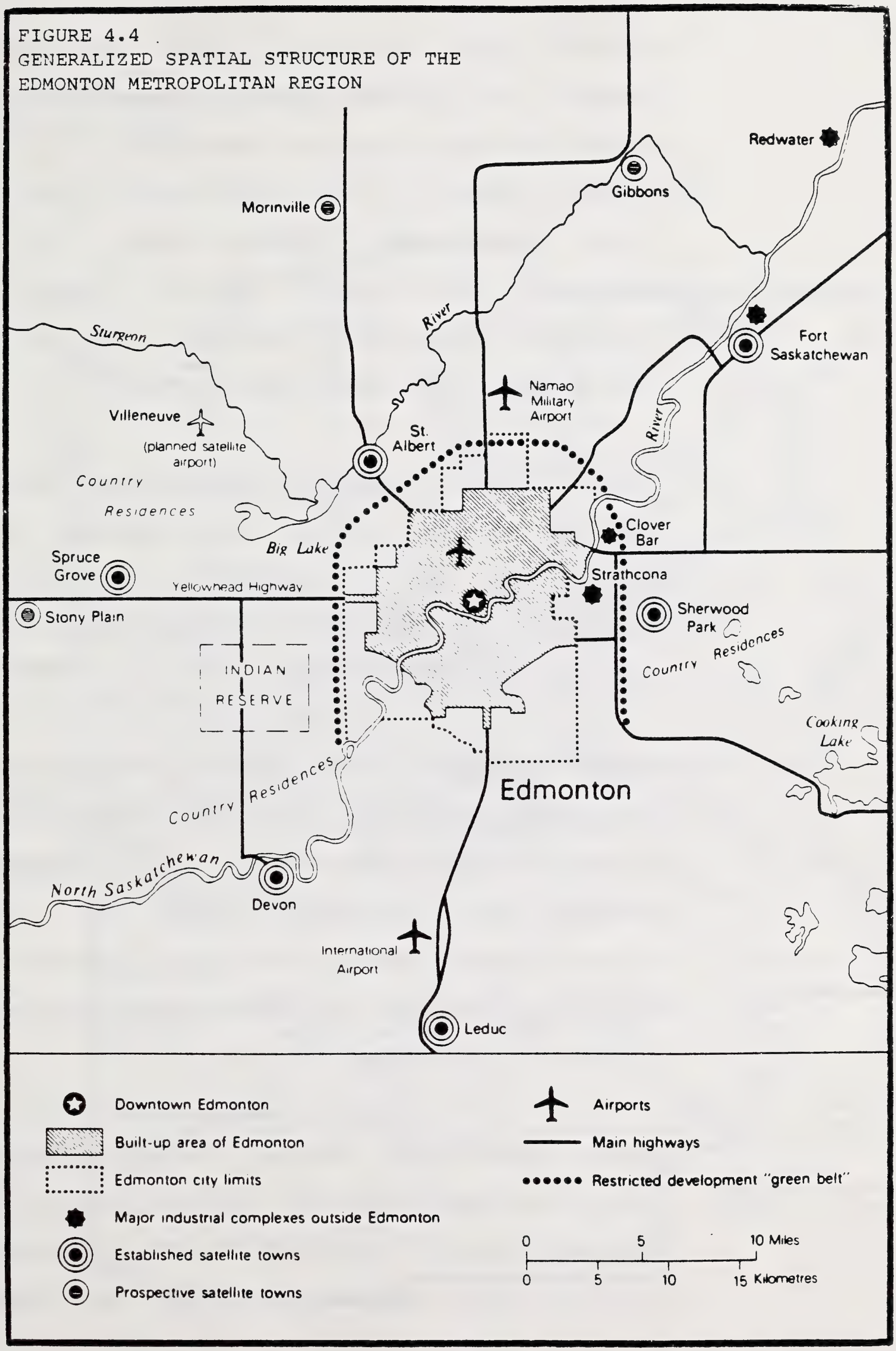

153 AVE
137 AVE
127 AVE
118 AVE
66 ST
VICTORIA TRAIL
97 ST
JASPER AVE
STONY PLAIN RD
170 ST
156 ST
142 ST
82 AVE
75 ST
50 ST
106 ST
91 ST
34 AVE
34 ST
▨ LAND ANNEXED 01/01/1982
OLD CITY BOUNDARY
NEW CITY BOUNDARY
N
FILE
DATE
PLANNING

FIGURE 4.4
GENERALIZED SPATIAL STRUCTURE OF THE EDMONTON METROPOLITAN REGION


Redwater
Gibbons
Morinville
Sturgeon
River
Fort Saskatchewan
Namao Military Airport
Villeneuve
(planned satellite airport)
St. Albert
River
Country Residences
Big Lake
Clover Bar
Spruce Grove
Yellowhead Highway
Strathcona
Stony Plain
Sherwood Park
Country Residences
INDIAN RESERVE
Cooking Lake
Country Residences
Edmonton
North Saskatchewan
Devon
International Airport
Leduc
Downtown Edmonton
Built-up area of Edmonton
Edmonton city limits
Major industrial complexes outside Edmonton
Established satellite towns
Prospective satellite towns
Airports
Main highways
Restricted development "green belt"
0
5
10 Miles
0
5
10
15 Kilometres

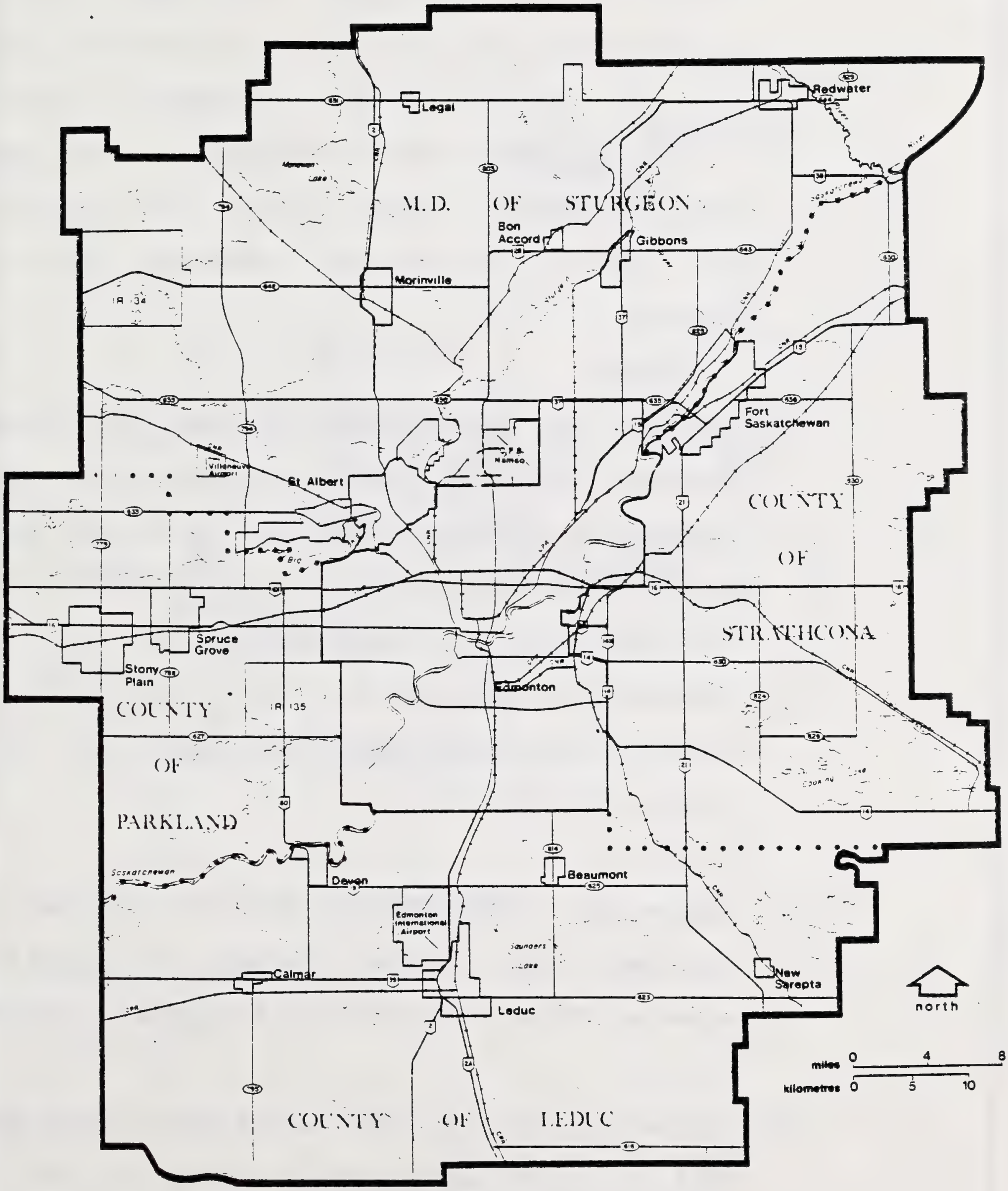
one-half mile increments, from the nearest property road access point to the nearest major highway. Major highways are designated as Alberta highway number 2, for north-south directional travel, and Alberta highway number 16, for east-west directional travel. Figure 4.5 illustrates a portion of the Alberta highway and road system in the Edmonton region.

9. Travel Distance to Edmonton CBD: Using the access base map, with the property locus plotted, travel distance by road is measured, in one-half mile increments, from the nearest property road access point to the Edmonton CBD.

10. Travel Distance to Edmonton City Boundary: Using the access base map, with the property locus plotted, travel distance by road is measured in one-half mile increments, from the nearest property road access point to the Edmonton City Boundary as adjusted for recent annexations and to conform to the date of the sale.

11. Travel Distance to Nearest Satellite Town CBD: Using the access base map, with the property locus plotted, travel distance by road is measured, in one-half mile increments, from the nearest

FIGURE 4.5
PORTION ALBERTA HIGHWAY MAP,
EDMONTON REGION


Legal
Redwater
M.D. OF STURGEON
Bon Accord
Gibbons
Morinville
IR 134
St Albert
C.F.B. Namao
Villeneuve Airport
Fort Saskatchewan
COUNTY OF STRATHCONA
Spruce Grove
Stony Plain
Edmonton
IR 135
COUNTY OF PARKLAND
Saskatchewan
Devon
Beaumont
Edmonton International Airport
Saunders Lake
Calmar
Leduc
New Sarepta
north
miles 0 4 8
kilometres 0 5 10
COUNTY OF LEDUC

property road access point to the nearest satellite town CBD.

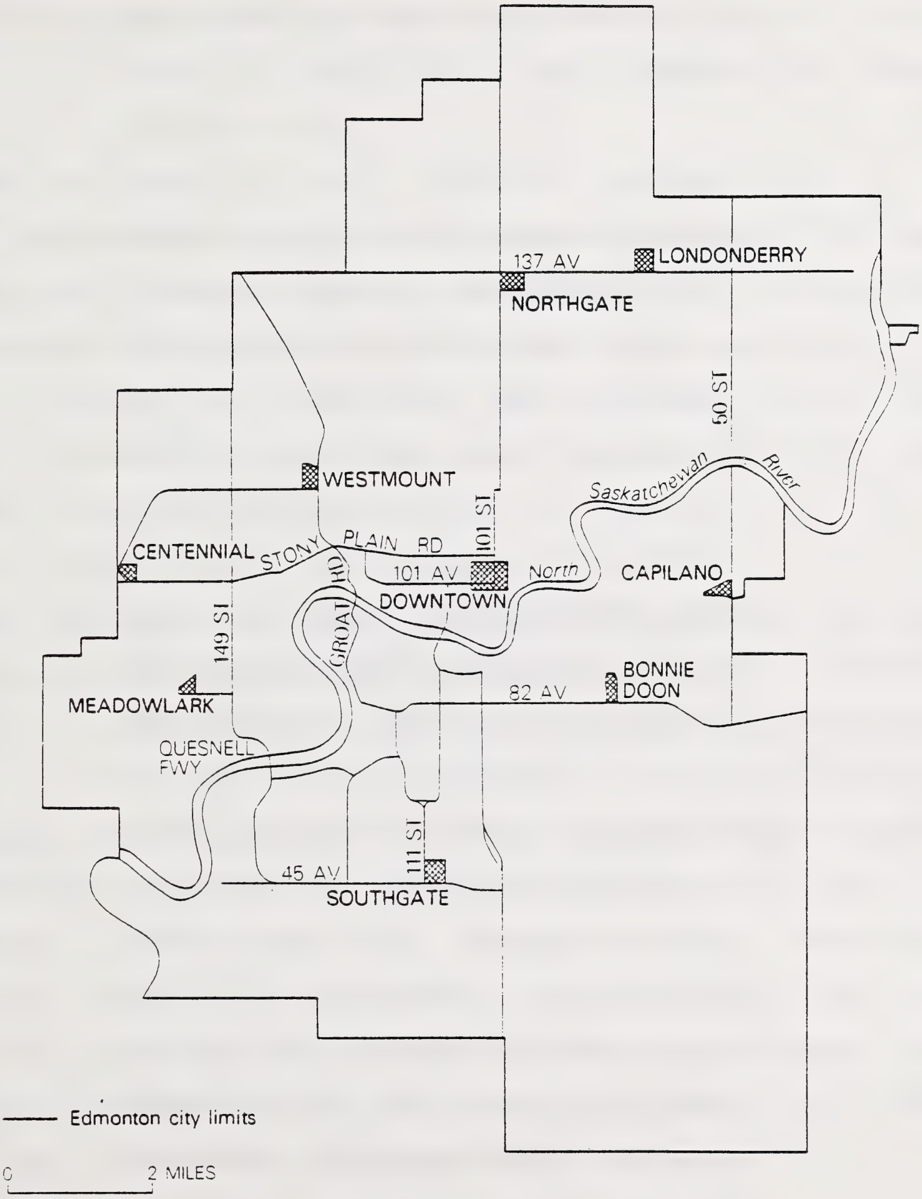
12. Travel Distance to Nearest Regional Shopping Center: Using the access base map, with the property locus plotted, travel distance by road is measured, in one-half mile increments, from the nearest property road access point to the nearest regional shopping center. Figure 4.6 illustrates the location of regional shopping centers in Edmonton.

13. Location in Metropolitan Fringe: The Edmonton Regional Planning Commission has delineated an area on the Composite Regional Land Use Map as Metropolitan Fringe. Parcel samples located within the Metropolitan Fringe are coded by dummy variable to represent the strength of urban influence on value. (Code 1=YES, 0=NO if located within urban fringe).

14. Population: Metropolitan Edmonton population is obtained from Alberta Bureau of Statistics reports. Data is recorded in thousands of persons.

15. Population Density: Population density per square mile is calculated for the township of the site

FIGURE 4.6
LOCATION OF MAJOR SHOPPING MALLS IN EDMONTON


137 AV
LONDONDERRY
NORTHGATE
50 ST
WESTMOUNT
101 ST
Saskatchewan River
North
CENTENNIAL
STONY PLAIN RD
101 AV
DOWNTOWN
CAPILANO
149 ST
GROAT RD
BONNIE DOON
82 AV
MEADOWLARK
QUESNELL FWY
111 ST
45 AV
SOUTHGATE
Edmonton city limits
0
2 MILES

location from Alberta Bureau of Statistics reports on Alberta Population by Township and Range. Data is recorded to the nearest whole person per square mile.

16. Measured Straight Line Distance to Nearest Approved Subdivision: Using the access base map, with the property locus plotted, the measured straight line aerial distance will be the shortest straight line distance, in one-half mile increments, from the property boundary to the boundary of the nearest approved subdivision at the date of the sale. Subdivision activity will be delineated on the access base map from recorded subdivision approval activity maps and is intended to measure future subdivison potential.

17. Geographic Segmentation: Sample data is segmented in four geographical dimensions representing county location to measure the effect of geographical differences in value due to directional differences in land use practice, development potential, level of municipal services provided and regulatory influences. The four counties each generally represent the four quadrants of the compass (North, South, East and West), are centered by a major transportation

route, contain Satellite Towns and represent clearly delineated homogenous planning areas. Data is coded by dummy variable to signify county location. (Code 1=YES, 0=NO if sample site located within county).

18. Frontage Road Condition: The condition of the road surface fronting the sample site is specified representing a measure quality classification of one to seven with one representing the best frontage road condition. Data is obtained from Alberta Highway Maps.

19. Potential Urban Expansion: The Edmonton Regional Planning Commission has designated the direction of potential development on the Policy Reference Map for the City of Edmonton and each satellite town located in the study area. Parcel samples which are located within the area of Potential Urban Expansion for residential, commercial, institutional and/or industrial land uses are coded as a dummy variable to represent the potential for urban expansion. (Code 1=YES, 0=NO if within designated expansion zone).

20. Zoning Classification: The current land zoning designation in effect at the time of sale is

classified in three basic zoning categories: residential, commercial/industrial and agricultural. Zoning classification is obtained by examination of the composite Regional Land Use Map prepared by the Edmonton Regional Planning Commission. Data is coded by dummy variable representing land use zoning in effect at the time of sale. (Code 1=YES, 0=NO for each zoning classification). Zoning classification is an indication of future potential highest and best use.

21. County Taxation Rate: The property taxation rate in effect in the county where the site is located will be specified to measure the impact of property tax levels on land value and as a proxy measure to represent the quality of municipal services that may be expected at various taxation rates. The county taxation rate will be measured in mills.

22. Location in Special Control Area: Location within regulated special land use control areas such as the Restricted Development Area, a Resource Conservation area or airport related control areas place restrictions on development potential. Parcel samples located within any special control

area are coded by dummy variable. (Code 1=YES, 0=NO if located in special control area).

23. Code to Represent Month of Sale: The date of each property transfer recorded on original Land Titles records will be coded monthly to account for the influence of time, commencing with the first month coded to equal 1 and each succeeding month is incremented by 1 until the final month of the study period is coded to equal 144 (January, 1971 = 1...December 1982 = 144).

24. Prime Interest Rate: The prime interest rate in effect during the month of sale is a measure of the discount rate and reflects financial conditions in the market at the time of property transfer. Data is obtained from the Bank of Canada Review. Table 4.4 presents the historical Canadian Chartered Bank prime business loan rate, percentage, monthly, January 31, 1971 to December 31, 1982. The prime business lending rate is the interest rate charged to the most credit-worthy borrowers. The rate is shown at month end. When there are differences in the rate charged by individual banks, the most typical rate or rates are taken. The rate shown in Table 4.4 applies to large business loans. Data is input in percentage

TABLE 4.4
CANADIAN CHARTERED BANK, PRIME BUSINESS LOAN RATE, PERCENT, MONTHLY, JANUARY 31, 1971 TO DECEMBER 31, 1982

	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec
1971	7.00	7.00	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.25	6.00	6.00
1972	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1973	6.00	6.00	6.00	6.50	7.00	7.75	7.75	8.25	9.00	9.00	9.00	9.50
1974	9.50	9.50	9.50	10.50	11.00	11.00	11.50	11.50	11.50	11.50	11.00	11.00
1975	10.50	9.50	9.00	9.00	9.00	9.00	9.00	9.00	9.75	9.75	9.75	9.75
1976	9.75	9.75	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	9.75	9.25
1977	9.25	8.75	8.75	8.75	8.75	8.25	8.25	8.25	8.25	8.25	8.25	8.25
1978	8.25	8.25	8.75	9.25	9.25	9.25	9.25	9.75	10.25	11.00	11.50	11.50
1979	12.00	12.00	12.00	12.00	12.00	12.00	12.50	12.50	13.00	14.75	15.00	15.00
1980	15.00	15.00	15.75	16.75	13.75	13.25	12.25	12.25	12.25	12.75	13.75	18.25
1981	18.25	18.25	17.75	18.25	19.50	20.00	21.00	22.75	21.25	20.00	17.25	17.25
1982	16.50	16.50	17.00	17.00	17.00	18.25	17.25	16.00	15.00	13.75	13.00	12.50

Source: Bank of Canada Review

terms to the nearest one-quarter of one percent.

25. Population Growth Rate: Population data were derived from the 1971, 1976 and 1981 Census of Canada and from Alberta Municipal Affairs estimates for all other years. Annual population growth rates are calculated to the nearest one tenth of one percent. Growth rates are lagged one year from the year of sale to represent the purchasers decision lead time in reaction to population increases.

26. Acres Transferred: The total number of acres of land transferred during the year of the sample land transfer will be input by county and year to the nearest acre. Data is obtained from Alberta Agriculture, Resource Economics Branch Report on Agricultural Real Estate Values.

27. Average Per Acre Value: The average per acre assurance fund value during the year of the sample land transfer will be input by county and year to the nearest dollar. Data is obtained from Alberta Agriculture, Resource Economics Branch, Report on Agricultural Real Estate Values.

28. Country Residential Parcels Created: The number of

country residential parcels created by county and year will be specified as a proxy measure of land market development activity. Data is obtained from the Edmonton Metropolitan Regional Planning Commission.

29. Area Subdivided for Country Residential: The total land area subdivided for country residential use by county and year will be specified as a proxy measure of land market activity. Data is obtained from the Edmonton Metropolitan Regional Planning Commission.

30. OPEC Variable: An opec variable is specified to represent the effect of energy costs for transportation, fertilizers and other input costs due to increases in energy prices. The Alberta Wellhead Oil Price is selected as a proxy measure to account for this effect. Data are obtained from Alberta Department of Energy and are input in dollars per barrel.

C. Summary

Chapter IV presented a description of the study area and a description of each of the variables, including data sources and variable measurement and calibration criteria.

A number of economic, spatial and time influenced variables are tested in the proposed model in order to determine those forces having an influence on land transaction price. Emphasis is placed on achieving realistic economic information which might contribute to improved decision making concerning land purchases in an urban influenced area. Therefore, statistical criteria are oriented towards improving the predictive capability and reliability of the model. Chapter V will present the analysis and empirical results of the proposed model.

V. ANALYSIS AND EMPIRICAL RESULTS

The general models and variables described in Chapter III are used in this Chapter to estimate a predictive model of transaction prices of land in the urban-rural fringe. Various model formulations are estimated in order to determine which variables have an influence on land transaction prices and thus improve the predictive power of an equation. Factor analysis is used to identify and simplify the dependence structure of the independent variables. As well, a number of different transformation measures and variable interaction effects of some independent variables are compared to determine which variable provides a superior predictive power.

To test the hypothesis that the land market in the urban-rural fringe study area can be conceptualized as submarkets, where the factors influencing land prices are significantly different from each other, the general model is estimated for sales data segmented by county location and land use.

Sample data are segmented in four geographic dimensions representing county location to measure the effect of geographic differences in land price due to county location, directional differences in land use practice, development potential, level of municipal services provided and regulatory influences. The four counties generally represent the four quadrants of the compass (North, South, East and West), are centered by a major transportation route, contain Satellite Towns and represent clearly delineated homogenous planning areas.

Sample data are also segmented by land use to measure the impact of use zoning on land prices. Generally, use zoning is expected to increase land prices as land use changes from agricultural to residential to commercial or multi-family. The factors influencing land prices in each land use submarket are expected to be significantly different from each other and unique to property characteristics and each specified land use classification.

The equations which appear to be the best predictors of transaction prices of land in the urban-rural fringe are presented in this Chapter along with their statistical results. Statistical interpretations and economic inferences of the results are made to provide a basis for economic conclusions and economic implications which are developed in Chapter VI.

This Chapter presents a descriptive statistical profile of sample data characteristics, model specification procedure and the analysis of results.

A. The Sample of Land Market Transaction Prices

Basic land titles data on real estate transfers were obtained from the Alberta Department of Agriculture, Resource Economics Branch, Economic Services Division in cooperation with the Department of Municipal Affairs and the Northern Alberta Land Titles Offices. Data for each parcel transferred included month and year of sale, number of acres transferred, total dollar assurance fund estimate and the legal description by Section, Township, Range and Meridian.

Additional data required for this study were either calibrated by calculation or measurement using the basic data as a reference point or obtained from appropriate demographic secondary data sources. Chapter IV contained a definition, scale of measurement and source of each variable specified in the land price predictor model. Table 3.1 presented summary of the independent variables used in the model estimation and their data sources.

On an aggregate scale, for the Province of Alberta, during the study period, 1971 -1982, there has been an average annual increase of 17.7 percent in average per acre price for agricultural real estate.[60] Average values per acre have risen from $67. per acre in 1971 to $470. per acre in 1982 for all of Alberta. Although the total agricultural real estate acreage transferred during the study period fluctuated, annual increases in the per acre price resulted in an increase in total value of agricultural real estate transferred in every year from 1971 to 1982. Figure 5.1, Figure 5.2 and Table 5.1 present summaries of Alberta Agricultural Real Estate data trends

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[60] Agricultural or possible agricultural real estate is defined by the Resource Economics Branch of Alberta Agriculture to include parcels of over 60 acres with recorded values between $5. and $1500. per acre on the date of registration of the land transfer.

FIGURE 5.1
AVERAGE VALUE PER ACRE, AGRICULTURAL REAL ESTATE,
ALBERTA, 1971 TO 1982

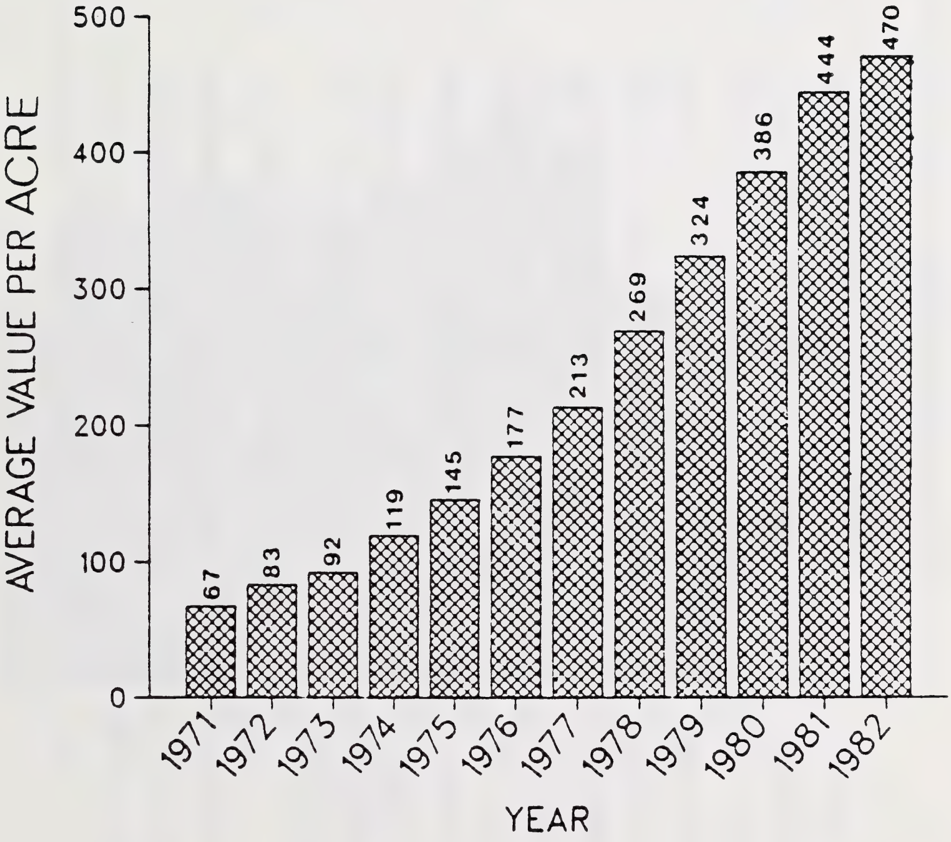


FIGURE 5.2
TOTAL ACRES TRANSFERRED, AGRICULTURAL REAL ESTATE,
ALBERTA, 1971 TO 1982

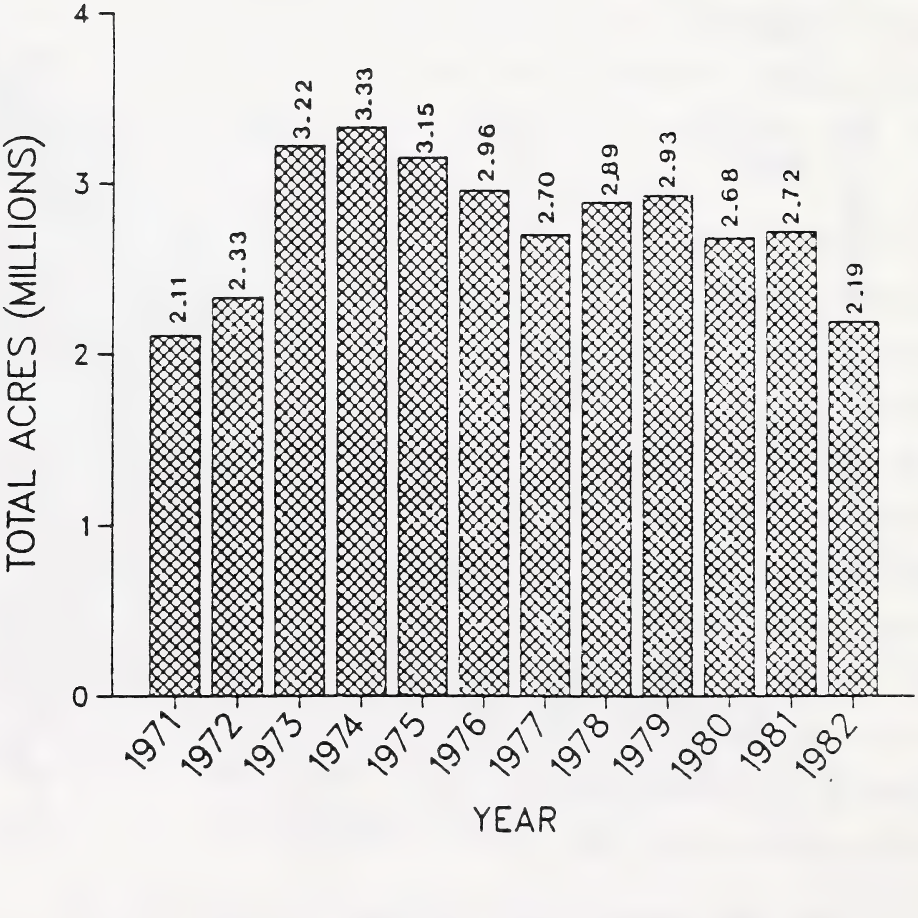


TABLE 5.1
ALBERTA AGRICULTURAL REAL ESTATE DATA REVIEW 1971-1982

Year	Total Acres Transferred	Annual Percent Change In Transfers	Average Value Per Acre	Annual Percent Change In Value	Total Value Transferred	Annual Percent Change In Total Value
1971	2,114,025	-	67.32	-	142,313.997	
1972	2,334,484	+10.4	83.10	+23.4	194,203,369	+36.5
1973	3,218,223	+37.9	91.72	+10.4	295,167,916	+52.0
1974	3,328,960	-3.4	118.92	+29.7	385,981,736	+34.2
1975	3,146,075	-5.5	144.83	+21.8	455,646,042	+15.1
1976	2,959,710	-5.9	177.39	+22.5	525,002,107	+15.2
1977	2,699,518	-8.7	213.39	+20.3	575,640,512	+9.6
1978	2,891,027	+7.1	269.12	+26.1	778,013,594	35.2
1979	2,929,154	+1.3	323.84	+20.3	948,521,547	+21.9
1980	2,681,710	-8.4	385.61	+19.1	1,034,028,407	+9.0
1981	2,718,437	+1.4	443.95	+15.1	1,206,865,647	+16.7
1982	2,194,714	-19.3	470.48	+6.0	1,032,569,043	-14.4

Source: Alberta Department of Agriculture, Resource Economics Branch,

Economic Services Division

for the study period, 1971 to 1982.

The sample selection area is delineated to include only those land transfers in the Edmonton region which were legally described by Section - Township - Range - Meridian. By definition the Edmonton region is inclusive of Townships 48 to 58 and Range 20, west of the 4th Meridian to Range 1, west of 5th Meridian. The sample selection area boundaries extend for a distance from the Edmonton CBD of approximately 32 miles to the north, 31 miles to the south, 27 miles to the east, and 22 miles to the west. A ten percent sample for each year of the study period was randomly selected from all land transfers for parcels of greater than or equal to ten acres within the defined Edmonton region.

The initial sample was modified to eliminate transactions which appeared not to represent an unencumbered market price. All transactions of $1000. or less in assurance fund estimate were excluded on the assumption that the nominal reported price represented a non arms-length exchange, an exchange between related individuals or to settle estates. Parcels of less than ten acres are classified as "country residential" developed land and were excluded as being not representative of aggregate urban-rural land market prices. An inspection of per acre prices eliminated unusual and extreme low and high observations also considered to be uncharacteristic of the land market. Whereas the study area boundaries, consisting of the Edmonton Metropolitan Regional Planning Commission Planning Area, did not conform to the sample collection area, as defined by Section - Township - Range - Meridian, all observations located beyond the study area boundaries were eliminated. Observations located within city or satellite town corporate limits, as of the transaction date, were also excluded. The final exclusion was for incomplete data within each observation consisting of unspecified transfer value, missing parcel size or incomplete legal description which prevented property location and variable calibration.

The final sample consists of 489 observations on 1971 to 1982 land transactions in the study area. Table 5.2 presents the number of valid observations for each year of the study period which are the subject of the analysis to follow. Table 5.3 presents a descriptive statistical profile of characteristics of the sample data.

The spatial distribution of sample observations indicates a wide distribution over the study area thereby conforming to one of the selection criteria previously established in Chapter III. Figure 5.3 illustrates a plotting of the location of sample observations within the study area.

A location preference may be observed, from the sample data location plot map in Figure 5.3, for parcels in close proximity to major highways, satellite towns, the major urban area and identified country residential subdivisions.

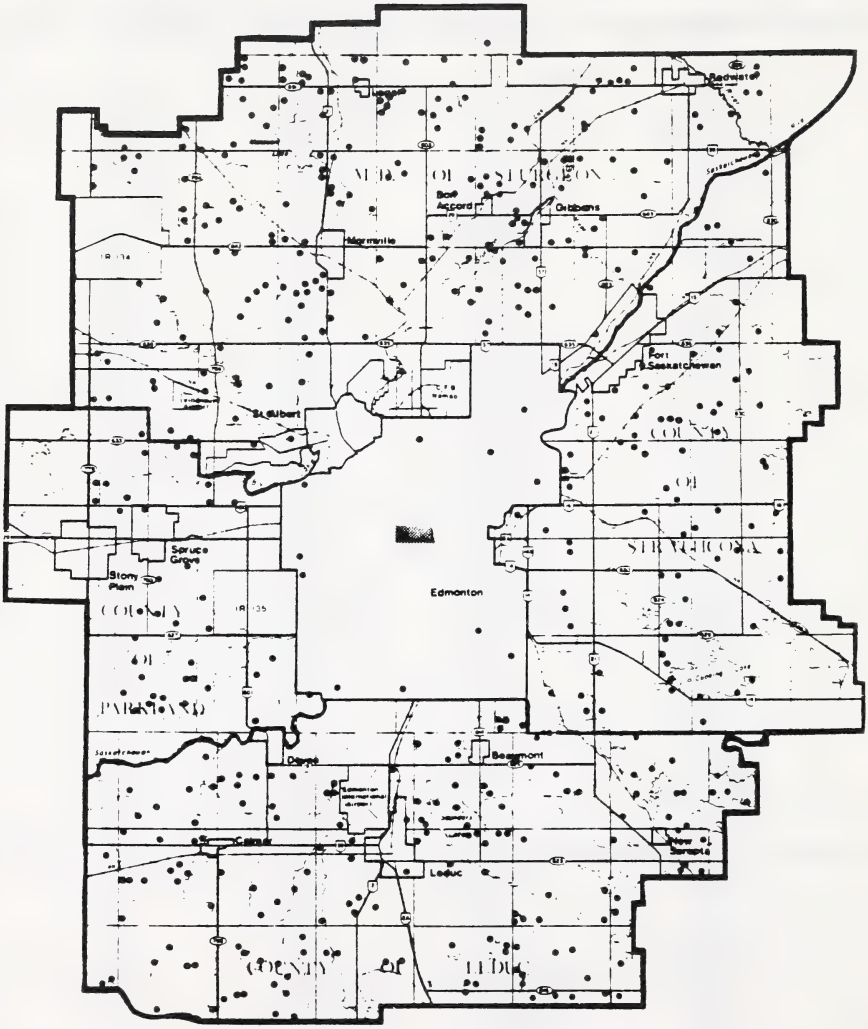
TABLE 5.2
SAMPLE OF LAND MARKET TRANSACTIONS
1971-1982

Year	Number of Observations
1971	51
1972	39
1973	43
1974	35
1975	36
1976	41
1977	38
1978	45
1979	49
1980	40
1981	43
1982	29
Total Number of Observations:	489

TABLE 5.3
CHARACTERISTICS OF THE SAMPLE OF LAND TRANSACTIONS, 1971 TO 1982

VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM
SALE	74890.004	68432.322	2746	333760
SIZE	137.730	54.267	18	397
DOLLAR	576.916	481.502	17	2086
TIME	67.701	40.243	1	144
POP	604.998	62.790	520	728
CPI	66.283	19.857	41.9	111.0
SCBD	21.863	6.177	7.0	37.0
SBRY	14.347	6.208	.0	30.0
SAT	7.291	4.369	.0	24.0
THWY	8.785	6.007	.0	28.0
TCBD	26.342	7.932	7.0	47.0
TBRY	18.544	8.139	.0	43.0
TSAT	9.206	5.620	.0	31.0
TSC	21.092	8.249	.0	46.0
SBDV	3.776	3.524	.0	23.0
INTRT	10.451	3.830	6.00	22.75
SOIL	2.527	1.599	0	9
URES	.133	.340	0	1
UCOM	.007	.081	0	1
UAG	.861	.347	0	1
METRO	.208	.406	0	1
DPOP	729 261	1214.812	0	9999
ASUB	303	.460	0	1
PARK	.088	.284	0	1
LEDUC	.316	.466	0	1
SCONA	.177	.382	0	1
STURG	.416	.493	0	1
ROAD	4.838	1.676	0	7
URBAN	.102	.303	0	1
ZRES	.334	.472	0	1
ZCOM	.020	.140	0	1
ZAG	.647	.478	0	1
TAXP	91.217	23.974	62	183
RDA	.073	.260	0	1
GPOP	3.102	.718	1.9	5.8
TRANS	36566.546	20005.497	278	71629
XVAL	441.595	279.456	60	1966
NCR	199.712	181.820	8	699
ACR	896.662	842.900	50	3730
OPEC	9.607	5.854	2.85	24.62

FIGURE 5.3
LOCATION MAP, SAMPLE OBSERVATIONS,
EDMONTON REGIONAL PLANNING COMMISSION
STUDY AREA


Redwater
Legal
M.D. OF STURGEON
Bon Accord
Gibbons
Morinville
IR 134
Fort Saskatchewan
St. Albert
COUNTY OF STRATHCONA
Spruce Grove
Stony Plain
COUNTY OF PARKLAND
IR 135
Edmonton
Saskatchewan
Cooking Lake
Devon
Beaumont
Edmonton International Airport
Calmar
Leduc
New Sarepta
COUNTY OF LEDUC

In addition, infrequent examples of small concentrations of land market activity and transactions involving adjacent land parcels may be observed. However, the sample observations generally represent a wide distribution over the study area with no identifiable concentrations of land market activity. Furthermore, no specific location within the study area may be identified as being void of any transactions and land market activity.

Table 5.4 presents a summary of the variables which are used in the analysis. The regression symbol, variable description and measurement units for the variables are presented to complement the presentation of data characteristics and statistical results. The variable descriptions and measurement units are particularly important components of both statistical and economic interpretations.

B. Regression and Factor Analysis Procedure

One of the objectives of this study is to examine certain variables in order to predict transaction prices of land in the urban-rural fringe of the Edmonton Metropolitan Region. This section of the study employs multiple regression analytical techniques to identify those independent variables which appear to have the strongest relationships with the dependent variable. Multiple regression summarizes the combined influence of a number independent variables on a designated dependent variable.

TABLE 5.4
IDENTIFICATION AND DESCRIPTION OF VARIABLES USED IN THE EMPIRICAL ANALYSIS

Regression Symbol	Description	Measurement Units
DEPENDENT VARIABLES:		
DOLLAR	Land Price Per Acre	Dollars Per Acre
ADOLLAR	CPI Adjusted Land Price Per Acre	Dollars Per Acre
SALE	Total Sale Price	Dollars
INDEPENDENT VARIABLES:		
	SITE CHARACTERISTICS:	
SIZE	Size of Parcel	Acres
SOIL	Canada Land Inventory Soil Class	Classification 1 to 9
URES	Land Use Residential	Dummy (1=Yes, 0=No)
UCOM	Land Use Commercial/Industrial	Dummy (1=Yes, 0=No)
UAG	Land Use Agriculture (Base Case)	Dummy (1=Yes, 0=No)
	ACCESSIBILITY:	
SCBD	Measured Straight Line Aerial Distance to Edmonton CBD	Miles
SBRY	Measured Straight Line Aerial Distance to Edmonton City Boundary	Miles
SAT	Measured Straight Line Aerial Distance to Nearest Satellite Town CBD	Miles
THWY	Travel Distance to Nearest Major Highway	Miles
TCBD	Travel Distance to Edmonton CBD	Miles
TBRY	Travel Distance to Edmonton City Boundary	Miles

TABLE 5.4 (continued):

Regression Symbol	Description	Measurement Units
TSAT	Travel Distance to Nearest Satellite Town CBD	Miles
TSC	Travel Distance to Nearest Regional Shopping Center	Miles
	ENVIRONMENTAL CHARACTERISTICS:	
METRO	Location in Metro Fringe	Dummy (1=Yes, 0=No)
POP	Metropolitan Edmonton Population	Thousands
DPOP	Population Density in Township/Range	Persons
SBDV	Measured Straight Line Aerial Distance to Nearest Approved Subdivision	Miles
ASUB	Location Within One Mile of Nearest Approved Subdivision	Dummy (1=Yes, 0=No)
PARK	Location in County of Parkland	Dummy (1=Yes, 0=No)
LEDUC	Location in County of Leduc	Dummy (1=Yes, 0=No)
SCONA	Location in County of Strathcona	Dummy (1=Yes, 0=No)
STURG	Location in M.D. of Sturgeon (Base Case)	Dummy (1=Yes, 0=No)
ROAD	Frontage Road Conditions	Classification 1 to 7
URBAN	Potential Urban Expansion	Dummy (1=Yes, 0=No)
	INSTITUTIONAL CHARACTERISTICS:	
ZRES	Zoned Residential/General Rural	Dummy (1=Yes, 0=No)
ZCOM	Zoned Commercial/Industrial	Dummy (1=Yes, 0=No)
ZAG	Zoned Agriculture (Base Case)	Dummy (1=Yes, 0=No)
TAXP	County Taxation Rate	Mills
RDA	Location in Special Control Area	Dummy (1=Yes, 0=No)

TABLE 5.4 (continued):

Regression Symbol	Description	Measurement Units
	LAND MARKET FACTORS:	
TIME	Code to Represent Month of Sale (Jan. 1971 = 1...Dec. 1982 = 144)	
INTRT	Prime Interest Rate in Effect Month of Sale	Percent
CPI	Annual Consumer Price Index For Edmonton	1981 = 100
GPOP	Population Growth Rate Edmonton Metro Region One Year Lagged	Percent
TRANS	Acres Transferred by County, and Year of Sale	Acres
XVAL	Average Per Acre Price by County, and Year of Sale	Dollars
NCR	Number of Country Residential Parcels Created by County and Year	Number
ACR	Land Area Subdivided for Country Residential by County and Year	Acres
OPEC	Alberta Wellhead Oil Price for Month of Sale	Dollars

In this study, the relationships between transaction prices and the independent variables are determined by using multiple regression and factor analysis programs contained in the Statistical Package for the Social Sciences (SPSSX).[61] A description of model specification and analysis procedure follows. Then an interpretation and evaluation of the results are presented.

Use of Dummy Variables

The use of dummy variables in regression analysis allows introduction of variables that cannot be expressed on a cardinal scale. This is accomplished by assigning a 1-0 "dummy" numerical scale to them; 1 = YES or 0 = NO. The procedure divides the observations on the dependent variable into classes specified by the "dummy" variables. The division, when significant, estimates the shift in intercept of the regression equation for the various classes.

For example, suppose the effect of land use on land price is to be estimated when land use is classified only as residential or agricultural. Two dummy variables, residential and agricultural are entered into the equation with each assigned a possible value of either 1 = YES or 0 = NO. In order to avoid matrix singularity, one of the dummy variables is deleted from the equation. The deleted variable becomes the base case. This technique produces estimates of two constant or Y-intercept values. The intercept value for the dummy variable deleted is given by the value of the constant in the estimated equation. The other intercept value is the value of the algebraic sum of the constant and the estimated coefficient of the dummy variable retained in the equation.

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[61] Norman H. Nie, et al., Statistical Package for the Social Sciences, User's Guide, New York: McGraw-Hill, 1983.

The procedure allows separation of the observations into more than two classes. Continuing the above example, land use might be classified as residential, agricultural and commercial. The same procedure is followed; that is, each of the three classes is entered into the equation as 1-0 dummy variable and one of the three is deleted to avoid matrix singularity. The resultant value of the constant in the estimated equation and the estimated coefficients of the dummy variables retained in the equation provide a means of deriving estimates of the parameters for the three classes of land use.

Introduction of dummy variable classifications into the regression model is equivalent to subdividing the data set into populations representing each dummy variable classification. The different populations are considered to represent the different dummy classifications of the independent variable. The use of dummy variable classifications permits the testing of the equality of regression functions for the different populations.

Seven dummy variables were introduced into the analyses at one time or another. Each dummy variable had two or more mutually exclusive classes. According to the procedure outlined, each observation was classified by assigning a value of 1 or 0 to each "dummy" class. This classification system resulted initially in 14 separate dummy variables, counting each class as a variable. Combinations of both variables and classes within variables reduced the number of dummy variables to 11. When several dummy variables were entered into a regression equation the resultant value of the constant (for adjusted intercept value) represented a summation of all dummy variables deleted to avoid matrix singularity plus the intercept of the original equation.

Interpretation of the estimates of parameters for the classes of dummy variables retained in the equation was similar to that for the sample case described above. Intercept values for each class of a dummy variable were derived by adding the respective parameter estimates to the adjusted constant. In other words, the parameter estimate of each dummy variable measured shifts in the regression as deviation from the intercept of the equation. Following the procedure outlined allowed class effects of dummy variables to be determined when more than one group of dummy variables was included in regression equations.

When dummy variables are included in the regression model interaction effects may be introduced into the model in the usual manner, by including cross-product terms. The purpose of adding interaction terms is to measure the effect of the difference in intercept and the shift in the slope for each dummy variable classification. When interaction is present the effect of the dummy variable is studied by comparing the regression functions for each classification of the dummy variables. The interaction model implies that each dummy variable classification has its own regression function, with different intercepts and different slopes for each dummy variable classification.

Model Specification and Analysis Procedure

Regression analysis is used to estimate the hypothesized relationships in a series of linear and transformed variable single equation models. Initially the general model is specified and estimated using the unconstrained full variable model as hypothesized. Correlations are examined and various model formulations are estimated to determine the significance of specified variables on land market transaction prices. Factor analysis is applied to reduce redundancy among variables and to identify a smaller number of underlying factors. Once the data has been reduced the next step involves application of the multiple regression procedure to estimate the reduced model.

The objective is to form a reduced regression model by specifying and testing only the most significant variables as determined by their respective coefficients and "t" test levels of significance.

To assist in choosing among the several independent variables that could be included in the model, stepwise regression procedure is utilized. Stepwise regression is a search technique that adds variables one at a time to the regression model. The criteria for inclusion in the model is that the calculated t-statistic for one or more variables has a significant probability of entry at the 0.10 level of significance. After the variables have been added the technique examines all of the variables included in the model and deletes any variable not significant at the specified level. The technique continues in this manner until no additional variables meet the criteria for entry into the model.

Emphasis in specifying the reduced model will be on reduction of multicollinearity. A priori judgement based on factors considered in formulating the general land value model will be used in the selection of variables for the reduced model specification.

Data transformations of expected nonlinear variables are tested next in an attempt to improve the predictive capability of the model. Examination of scatterplots and residual analysis may provide evidence of violation of model assumptions. If the model is not linear either alternative models must be formulated or variable transformations tested to improve the adequacy of the current model. Theoretical or a priori considerations form the basis for reformulating the model or selecting appropriate variable transformations. If the theoretical model is not appropriate, suitable transformations to improve the fit of the relationship may be suggested by examining plotted data. After variable transformations are selected, examination of residual plots will confirm that the linear regression model is appropriate for the transformed variables.

Although a number of reduced variable and transformed variable models are formulated and tested only the regressions that produce the most significant conclusions are reported.

An optimum predictive model of transaction prices of land in the urban-rural fringe is selected for further analysis of segmented data sets. The data is stratified by county location and land use to facilitate testing of the predictive capability of the optimum model along these micro market dimensions. The predictive capability of the model is tested and validated by using the estimated model to predict transaction prices of the dependent variable and comparing the results to actual transaction prices.

C. Regression Results of the Full Variable Model

This section consists of specification and estimation of the unconstrained full variable model as hypothesized. All of the variables previously identified and described in Table 5.4 are introduced into the full variable regression analysis model of land market transaction prices. The dependent variables tested are land price per acre (DOLLAR), CPI adjusted land price per acre (ADOLLAR) and total sale price (SALE). All other variables are specified as independent variables.

Standard errors are used in calculating the t-statistic to test the statistical significance of the estimated coefficients at the 0.10 level of significance. For the empirical results presented, the reliability of the estimated coefficients are tested with the t-statistic to determine whether the independent variable has a statistically significant influence on the dependent variable at the 0.10 level of significance.

The P-value is the probability that the sample value would be at least as large as the value actually observed, if the null hypothesis is true. It is the area in the tail beyond the observed value. The P-value is a function of the null hypothesis and the test statistic and is a measure of the credibility of the null hypothesis. Given the nature of the null hypothesis the P-value is the probability that the observed value is more extreme than the sample value.

The P-value is the probability that the sample outcome could be more extreme than the observed outcome. Large P-values support the null hypothesis while small P-values reject the null hypothesis. A significance test is carried out by comparing the P-value with the specified 0.10 significance level. If the P-value is less than 0.10 the null hypothesis is rejected.

The regression results for the full variable model are presented in Table 5.5, Table 5.6 and Table 5.7 for the dependent variable, DOLLAR, ADOLLAR and SALE respectively. These estimates are derived from the general model 3.2 outlined in Chapter III. Reported in the Tables are the coefficient of determination, R^2, adjusted R^2, the F-statistic for the equation, the regression coefficients, P-values, and t-statistics for the independent variables which are grouped by theoretical variable classification. The coefficients are shown in both unstandardize and standardized form. Unstandardized coefficients (b-values) are used to weight values of the independent variables for prediction purposes. The standardized coefficients (Betas) indicate the relative significance of individual variables in the relationship.

The full variable regression equation, with DOLLAR as the dependent variable, results in a R^2 of 0.54. The coefficients of determination, R^2, with ADOLLAR and SALE as the dependent variables are 0.36 and 0.54 respectively. To review, the coefficient of multiple determination, R^2, measures the percentage of total variance in the dependent variable that is explained by the independent variables. Therefore, the full variable regression equations estimated using 1971 to 1982 sample data on the specified variables account for 54 percent, 36 percent and 54 percent of the variance in the dependent variables DOLLAR, ADOLLAR and SALE respectively.

Analysis of results of the full variable model with DOLLAR, ADOLLAR and SALE as the dependent variables follows.

Analysis of Results with DOLLAR Dependent Variable

The regression results for the full variable model with DOLLAR as the dependent variable are presented in Table 5.5. The estimated regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.54. Adjusted R^2 is 0.53. The standard error of the estimate is $329.10 with an average (mean) predicted price of $576.92 per acre. The coefficient of determination is reasonable. However, the standard error of the estimate is approximately 57 per cent of the mean.

With DOLLAR as the dependent variable eight of the thirty-six independent variables entered the equation calculated to be statistically significant at the 0.10 level of probability using a one tail test: size of parcel (SIZE), travel distance to Edmonton CBD (TCBD), location in Edmonton metropolitan fringe (METRO), population density in Township/Range (DPOP), measured straight line aerial distance to nearest approved subdivision (SBDV), location in the County of Leduc (LEDUC), consumer price index for Edmonton (CPI) and number of acres transferred by county and year of sale (TRANS). Whereas, all other variables were not significant at least at the 0.10 level, using a one tail test, they were not included in the equation. A one

TABLE 5.5
REGRESSION RESULTS OF FULL VARIABLE MODEL
WITH DOLLAR AS DEPENDENT VARIABLE

	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
SITE CHARACTERISTICS:				
SIZE	-0.460	-0.052	-1.584	0.0569
ACCESSIBILITY:				
TCBD	-12.156	-0.200	-3.991	0.0000
ENVIRONMENTAL:				
METRO	-93.862	-0.079	-1.951	0.0258
DPOP	0.037	0.094	2.624	0.0045
SBDV	-8.773	-0.064	-1.584	0.0569
LEDUC	161.710	0.156	3.453	0.0003
LAND MARKET FACTORS:				
CPI	17.012	0.702	21.113	0.0000
TRANS	-0.001	0.061	1.412	0.0793
CONSTANT	-139.423		-1.262	0.1000
F-TEST	65.301			0.0000
R^2	0.541			
ADJ. R^2	0.533			
STD. ERROR	329.102			
MEAN	576.92			

Full regression model: DOLLAR = 180.904 -8.955 OPEC -0.005 TRANS -227.451 ZCOM -2.395 PARK +5.361 ROAD +0.773 SOIL -0.446 SIZE +78.086 RDA +0.029 DPOP -10.006 SAT +0.035 NCR +19.838 URBAN -0.624 THWY +69.670 URES -3.571 SBDV +247.828 UCOM +0.033 XVAL -10.422 ZRES -82.878 METRO +47.058 ASUB -4.701 SBRY +0.041 ACR -111.278 SCONA +254.279 LEDUC +51.762 GPOP +24.946 INTRT +7.370 TSAT +0.076 TAXP -9.061 TBRY -0.892 SCBD +15.752 TSC -15.839 TCBD +7.021 TIME.

tail test is selected as appropriate because the direction can be specified through a priori reasoning. The full regression function including all of the variables entered, regardless of significance level is reported in the notes to Table 5.5.

The coefficients generally conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance accessibility measures and development restrictions or positively related to economic measures and potential for development.

Coefficients for the measures of economic development to enter the equation, CPI and DPOP, are positive as an expected indication of the positive force of increased levels of population, employment and economic development forces on land prices. The positive coefficient for LEDUC is an indication of comparatively higher land prices which are characteristic of the County of Leduc as a result of increased land market activity in this county.

Coefficients for the accessibility measures of distance, TCBD and SBDV, are negative as theorized. The negative coefficent for SIZE reflects the theoretical effect of plattage on land price. METRO is negative reflecting the expectation of increased land development costs due to added regulatory measures from location within the area defined as metropolitan fringe by the Edmonton Metropolitan Planning Commission. The negative coefficient for TRANS is more difficult to interpret. TRANS may be considered an indicator of satisfied market demand.

Direct comparison of regression coefficients between independent variables is not possible because the estimated coefficients depend on the units in which the variables are measured as well as the relationship between the variables. By expressing each variable in terms of its standard deviation the relationships are made comparable. The model is expressed in terms of the standardized variables, the beta coefficients. Ignoring the sign, the beta coefficients indicate the relative importance of the respective independent variables in their relationship with the dependent variable. The greater the absolute value of the beta coefficient, the larger the relative importance of the independent variable in accounting for variation in the dependent variable. The sign and statistical significance of beta coefficients correspond with their respective regression coefficients.

The beta coefficients presented in Table 5.5 indicate that CPI, TCBD and LEDUC are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. CPI is the single most important variable. The correlation coefficient between DOLLAR and CPI is 0.691 and CPI alone accounts for 47.7 percent of the variance in land price per acre. Holding all other variables constant, land price per acre, DOLLAR, increased by $17.01 for every increase of one percentage point in the CPI, consumer price index for Edmonton. The high level of significance of CPI resulted because land price per acre in the DOLLAR model has not been adjusted to account for the effects of inflation on land price.

Travel distance to Edmonton CBD (TCBD) is also highly significant and conforms to the theoretical direction. Land price per acre is decreased by $12.16 for each additional mile of travel distance that the sample observation is located from Edmonton CBD.

Location in the County of Leduc is highly significant whereas location in the other counties specified was not significant at the 0.10 level. Holding all other variables constant, location in the County of Leduc increased the intercept price by $161.71 per acre or $22.29 per acre more than land located in the average county. Higher land prices in the County of Leduc are the result of high levels of industrial and energy (oil and gas) related activity located within the County. Also highway number 2, the major transportation corridor in Alberta, bisects the County influencing land prices. On the other hand location in the Edmonton metropolitan fringe (METRO) depressed the price by $93.86 per acre.

The SIZE of land parcel in acres of the transaction was theorized to decrease the average price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. SIZE is significant at the 0.057 level of significance. The -0.46 regression coefficient indicates that the price per acre of an average parcel decreases by $0.46 per acre for each additional acre of land in the parcel. The effect of parcel size has been generally factored out when using DOLLAR, land price per acre, as the dependent variable.

Analysis of Results with ADOLLAR as Dependent Variable

The regression results for the full variable model with ADOLLAR as the dependent variable are presented in Table 5.6. The estimated regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.36. Adjusted R^2 is 0.34. The drop in R^2 in comparison with the DOLLAR model is the result of adjusting the land price per acre with the CPI to account for the factoring out of the effects of inflation on land price. Whereas, CPI was the single most important variable in the DOLLAR model the drop in R^2 was not unexpected.

The standard error of the estimate is $435.20 with an average (mean) predicted price of $799.10 per acre.[62] The standard error of the estimate is 54 percent of the mean. The standard error of $435.20 for the ADOLLAR model is higher than the standard error of $329.10 for the DOLLAR model.

With ADOLLAR as the dependent variable thirteen out of thirty-three independent variables entered the equation calculated to be statistically significant at the 0.10

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[62] The results presented in Table 5.6 for ADOLLAR are multiplied by 100 to convert to a comparable scale with the DOLLAR model and allow for the percentage point adjustment by the CPI.

TABLE 5.6
REGRESSION RESULTS OF FULL VARIABLE MODEL WITH ADOLLAR AS DEPENDENT VARIABLE

	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
SITE CHARACTERISTICS:				
SIZE	-0.008	-0.078	-1.983	0.0240
URES	1.333	0.085	1.837	0.0334
ACCESSIBILITY:				
SBRY	-0.988	-0.115	-1.372	0.0854
TCBD	-0.148	-0.219	-2.469	0.0069
ENVIRONMENTAL:				
METRO	-1.312	-0.100	-2.032	0.0214
POP	0.096	1.125	4.598	0.0000
DPOP	0.0004	0.102	2.207	0.0139
ASUB	0.843	0.072	1.508	0.0662
LEDUC	2.842	0.247	3.896	0.0001
SCONA	-1.536	-0.110	-2.087	0.0187
LAND MARKET FACTORS:				
OPEC	-0.602	-0.659	-2.697	0.0037
ACR	0.0007	0.110	2.283	0.0115
TRANS	-0.00004	-0.147	-2.436	0.0076
CONSTANT	-38.174		-3.667	0.0002
F-TEST	18.842			0.0000
R^2	0.359			
ADJ. R^2	0.340			
STD. ERROR	4.352			
MEAN	7.991			

Full regression model: ADOLLAR = -37.476 -0.604 OPEC -0.0001 TRANS -2.679 ZCOM -0.387 PARK +0.058 ROAD -0.007 SOIL -0.008 SIZE +1.041 RDA +0.0004 DPOP -0.050 SAT -0.001 NCR +0.882 URBAN -0.036 THWY +1.477 URES -0.058 SBDV +4.502 UCOM +0.001 XVAL -0.223 ZRES -1.479 METRO +0.729 ASUB -0.087 SBRY -0.001 ACR -1.685 SCONA +2.745 LEDUC +0.249 GPOP +0.011 INTRT +0.033 TSAT -0.005 TAXP -0.195 TBRY -0.040 SCBD +0.242 TSC -0.135 TCBD +0.092 POP.

level of probability using a one tail test: size of parcel (SIZE), land use residential (URES), travel distance to Edmonton City boundary (TBRY), travel distance to Edmonton CBD (TCBD), location in Edmonton metropolitan fringe (METRO), metropolitan Edmonton population (POP), population density in Township/Range (DPOP), location within one mile of nearest approved subdivision (ASUB), location in the County of Leduc (LEDUC), location in the County of Strathcona (SCONA), Alberta wellhead oil price (OPEC), land area subdivided for county residential (ACR) and number of acres transferred by county and year of sale (TRANS). Whereas, all other variables were not significant at least at the 0.10 level, using a one tail test, they were not included in the equation. The full regression function including all of the variables entered, regardless of significance level, is reported in the notes to Table 5.6.

The coefficients generally conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

Coefficients for the measures of economic development to enter the equation, POP and DPOP, are positive as an expected indication of the positive force of increased levels of population employment and economic development forces on land prices. The negative coefficient for OPEC reflects additional factor costs for transportation, fertilizers and other input costs due to increases in energy prices. The positive coefficient for LEDUC is an indication of comparatively higher land prices which are characteristic of the County of Leduc as a result of increased land market activity in this county. On the other hand, the negative coefficient for SCONA is an indication of comparatively lower land prices which are characteristic of the County of Strathcona land market due to increased regulatory requirements and difficulty in obtaining land development approval.

Coefficients for the accessibility measures of distance, TCBD, SBRY and SBDV, are negative as theorized. The negative coefficient for SIZE reflects the theoretical effect of plattage on land price. METRO is negative reflecting the expectation of increased land development costs due to added regulatory measures from location within the area defined as metropolitan fringe by the Edmonton Metropolitan Planning Commission. The positive coefficient for ASUB conforms to the expected direction as confirmation of increased land prices for potential future land use for residential development. The negative coefficient for TRANS is again more difficult to interpret. TRANS may be considered an indicator of satisfied market demand.

The beta coefficients presented in Table 5.6 indicate that POP, OPEC, TCBD, and LEDUC are the most important variables in explaining variation in the dependent variable, ADOLLAR, CPI adjusted price per acre. POP is the single most important and highly significant variable and replaces CPI in the ADOLLAR model to account for the effects of inflation on land price. The correlation coefficient between ADOLLAR and POP is 0.450 and POP alone accounts for 20.2 percent of the variance in CPI adjusted land price per acre. Holding all other variables constant ADOLLAR increased by $9.60 for each increase of 1,000 in population for metropolitan Edmonton.

The Alberta wellhead oil price, OPEC, is also highly significant and conforms to the a priori direction. CPI adjusted land price per acre is decreased by $60.20 for each increase of $1.00 in the wellhead oil price.

Travel distance to Edmonton CBD (TCBD) is highly significant and conforms to the theoretical direction. CPI adjusted land price per acre decreased by $21.90 for each additional mile of travel distance that the sample observation is located from the Edmonton CBD.

Location in the County of Leduc is again highly significant at the 0.0001 level while location in the County of Strathcona is significant at the 0.0187 level of significance. Holding all other variables constant, location in the County of Leduc increased the intercept price by $284.20 while location in the County of Strathcona decreased the intercept price by $153.60 per acre. In effect land parcels located in the County of Leduc on the average command prices which are $437.80 per acre higher than land parcels located in the County of Strathcona.

Higher land prices in the County of Leduc are, once again, the result of high levels of industrial and energy related activity located within the County. The major transportation corridor in Alberta, highway number 2, also bisects the County influencing land prices. The negative influence on land prices from location in the County of Strathcona is the result of increased regulatory requirements, difficulty in obtaining development approval, problems of subdividing land for country residential use, increased costs of servicing land and costs of providing infrastructure in this County.

The size of land parcel purchased varied inversely to the adjusted price per acre as theorized. SIZE is significant at the 0.024 level of significance. The -0.80 regression coefficient indicates that the price per acre of an average parcel decreases $0.80 per acre for each additional acre of land in the parcel. The effect of parcel size has, once again, been generally factored out when using ADOLLAR, CPI adjusted land price per acre, as the dependent variable.

Potential for future residential land use is captured in the combined effect of the variables significant at least at the 0.10 level estimated to measure URES, ASUB, SBRY and ACR characteristics on the average adjusted land price per acre. The average price per acre in the ADOLLAR model is increased by $133.30 for land use residential (URES), by $84.30 for location adjacent to an approved residential subdivision and by $0.07 for each acre of Country Residential land transferred in the county in the year of sale. The average adjusted price per acre is decreased by $98.80 for each additional mile of straightline distance that the sample observation is located from the Edmonton CBD. The above residential land characteristics reflect a priori theoretical expected effects on land prices.

The same variables that were significant in the DOLLAR model are significant in the ADOLLAR model with the exception of CPI which was not specified as an independent variable and SBDV whose effect has been replaced and captured by the ASUB variable. Additional variables which are significant at the 0.10 level to enter the model include: POP and OPEC which together replace CPI as a measure of inflation effects, and URES, SBRY, ASUB, and ACR which measure the potential for future residential land use on land price per acre. In addition, the SCONA variable is included in the ADOLLAR model to measure additional effects of county location on land prices.

Analysis of Results with SALE as Dependent Variable

The regression results for the full variable model with SALE as the dependent variable are presented in Table 5.7. The estimated regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.54. Adjusted R^2 is 0.53. This is

TABLE 5.7
REGRESSION RESULTS OF FULL VARIABLE MODEL WITH SALE AS DEPENDENT VARIABLE

	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability> t (Significant t)
SITE CHARACTERISTICS:				
SIZE	436.254	0.346	10.443	0.0000
URES	12187.829	0.061	1.663	0.0485
ACCESSIBILITY:				
TCBD	-2993.621	-0.347	-3.283	0.0005
TSC	1269.623	0.153	1.488	0.0687
ENVIRONMENTAL:				
METRO	-11327.520	-0.067	-1.612	0.0589
POP	1192.549	1.094	4.700	0.0000
DPOP	4.110	0.073	1.900	0.0290
SBDV	-1562.561	-0.080	-1.919	0.0279
LEDUC	28368.732	0.193	4.639	0.0000
LAND MARKET FACTORS:				
GPOP	11661.775	0.122	2.150	0.0165
INTRT	1899.362	0.106	1.498	0.0674
OPEC	-6957.263	-0.595	-2.399	0.0084
ACR	6.832	0.084	2.106	0.0179
CONSTANT	-655249.548		-4.966	0.0000
F-TEST	39.361			0.0000
R^2	0.539			
ADJ. R^2	0.525			
STD. ERROR	47158.300			
MEAN	74890.004			

Full regression model: SALE = -71934.05 -3697.39 OPEC -0.54 TRANS -27224.21 ZCOM -998.65 PARK +1698.16 ROAD -394.84 SOIL +438.96 SIZE +13038.52 RDA +4.35 DPOP -537.40 SAT +2.05 NCR -532.18 URBAN -72.70 THWY +12580.84 URES -1177.09 SBDV +26821.12 UCOM +9.87 XVAL -2448.34 ZRES -8983.03 METRO +7248.41 ASUB -1474.67 SBRY +7.08 ACR -14158.32 SCONA +36754.25 LEDUC +10598.51 GPOP +4179.21 INTRT +193.42 TSAT +22.41 TAXP -702.89 TBRY +949.06 SCBD +2424.75 TSC -3000.52 TCBD +1173.84 TIME.

identical to the results obtained in the DOLLAR model. The standard error of the estimate is $47158.30 with an average predicted (mean) price of $74890.00 for sample land parcels sold. The standard error of the estimate is 63 percent of the mean.

With SALE as the dependent variable thirteen out of thirty-five independent variables entered the equation calculated to be statistically significant at the 0.10 level of probability using a one tail test: size of parcel (SIZE), land use residential (URES), travel distance to Edmonton CBD (TCBD), travel distance to nearest regional shopping centre (TSC), location in Edmonton metropolitan fringe (METRO), metropolitan Edmonton population (POP), population density in Township/Range (DPOP), population growth rate for Edmonton metopolitan area (GROP), measured straight line aerial distance to nearest approved subdivision (SBDV), location in the County of Leduc (LEDUC), prime interest rate (INTRT), consumer price index for Edmonton (CPI), number of acres transferred by county and year of sale (TRANS), land area subdivided for country residential(ACR), and Alberta wellhead oil price (OPEC). Whereas, all other variables were not significant at least at the 0.10 level using a one tail test, they were not included in the equation. The full regression function including all of the variables entered, regardless of significance level, is reported in the notes to Table 5.7.

The coefficients generally conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

Coefficients for the measures of economic development to enter the equation, POP, GPOP, DPOP and INTRT are positive as an expected indication of the positive force of increased levels of population, employment and economic development forces on land prices. The negative coefficient for OPEC reflects additional factor costs for transportation, fertilizer and other input costs due to increases in energy prices. The positive coefficient for LEDUC is an indication of comparatively higher land prices which are characteristic of the County of Leduc as a result of increased land market activity in this county.

Coefficients for the accessibility measures of distance, TCBD and SBDV, are negative as theorized. The negative coefficent for SIZE reflects the theoretical effect of plattage on land price. METRO is negative reflecting the expectation of increased land development costs due to added regulatory measures from location within the area defined as metropolitan fringe by the Edmonton Metropolitan Planning Commission. The positive coefficient for ACR confirms an increase in this supply variable. The coefficient for TSC is unexpectedly negative.

The beta coefficients presented in Table 5.7 indicate that POP, OPEC, SIZE, TCBD and LEDUC are the most important variables in explaining variation in the dependent variable, SALE, total land parcel sale price. POP is again the single most important and highly significant variable which accounts for the effects of inflation on land price. The correlation coefficient between SALE and POP is 0.591 and POP alone accounts for 35 percent of the variance in total sale price. Holding all other variables constant, total sale price increased by $1192.55 for each increase of 1,000 in population for metropolitan Edmonton.

The Alberta wellhead oil price, OPEC, is also highly significant and conforms to the expected a priori direction. Total sale price is decreased by $6957.26 for each increase of $1.00 in the wellhead oil price.

Travel distance to Edmonton CBD (TCBD) is highly significant and conforms to the theoretical direction. Total sale price is decreased by $2993.62 for each additional mile of travel distance that the sample observation is located from the Edmonton CBD.

Location in the County of Leduc is again highly significant. Holding all other variables constant, location in the County of Leduc increased the intercept total sale price by $28,368.73 for the average land parcel sold. Reasons for higher land prices for the County of Leduc have been previously described.

The full effect of parcel size on total sales price in the SALE model is observed. The SIZE variable is highly significant and is identified as an important variable in the SALE model. The average total sale price of land increased at the rate of $436.25 for each additional acre of land in the parcel.

New variables significant at the 0.10 level entered the SALE model which were not in either the DOLLAR model or the ADOLLAR model. They include TSC, GPOP and INTRT which are economic factors and measures of potential for future development.

D. Residual Analysis

Initial regression analysis was performed on the full variable models to determine the relative predictive power of the independent variables selected for the price predictor model. The coefficient of multiple determination, R^2, with DOLLAR as the dependent variable, was 0.54. This model is examined further and analyzed for adequacy and conformity to model assumptions.

Model assumptions, such as linearity of the regression function, normality of the error term, and constant variance are examined for appropriateness of the model. Residual plots are examined and analyzed to detect model inadequacy.

To examine the normality assumption residuals are plotted in comparison with the cumulative normal distribution and departures from normality are analyzed. The normality assumption is also analyzed by examining a histogram of residuals and the normal probability distribution of residuals in comparison with a normal distribution of residuals. Standardized residuals are examined to detect departures from normality.

Plots of residuals on predicted values of the dependent variable are used to detect model inadequacy. If the plot indicates that the residuals are contained in a horizontal band centered around zero, with no systematic tendency to be positive or negative, there are no obvious model defects. Plots of the residuals against the corresponding values of the independent variables are examined for similar patterns. Examination of these plots is also useful to confirm the assumptions of constant variance and normality. Variable transformations are tested to correct for model deficiences.

An iterative procedure is applied to test for the existence of expected non-linear relationships. The most important independent variable is examined for non-linearity. If non-linearity is discovered variable transformations are formulated and tested with the objective of improving the fit and predictive capability of the model. The next most important independent variable added is examined for non-linearity and tested for possible transformation. The iterative process testing for non-linearity and transformation effects continues until all of the expected non-linear independent variables are tested.

Scatter plots and partial plots of the residuals of the variables selected for testing are examined for expected non-linear relationships. Various transformations are applied to the variables including natural logarithms and reciprocals of various orders.

Theoretical or a priori considerations form the basis for reformulating the model or selecting appropriate variable transformations. If the theoretical model is not appropriate , suitable transformations to improve the fit of the relationship may be suggested by examining the plotted data. After variable transformations are selected, examination of residual plots will confirm that the linear regression model is appropriate for the transformed variables.

Theory suggests a declining non-linear relationship between parcel size and land transaction price. Examination of the data and testing of various transformations on the SIZE variable did not support this theoretical relationship. An examination of the frequency distribution of the SIZE variable and the plot of the relationship between, dollars per acre, DOLLAR and SIZE revealed a high frequency of observations ranging between 80 acres and 160 acres. It is expected that these observations are in a relatively linear portion of the declining SIZE and DOLLAR relationship curve. As a result the transformations tested produced marginal results and did not improve the fit of the model.

Theory also suggests a declining non-linear relationship between distance accessibility measures and land transaction price. Examination of data plots and transformation testing of all of the accessibility variables did not support this theoretical relationship. By definition the study area excluded all observations located within the Edmonton city boundary. The effective rent-bid function for the relationship between price and distance is measured from an approximate minimum distance of seven miles to a maximum distance of thirty miles from the Edmonton CBD. In effect the study area represented the agricultural land use category which is theoretically represented by a relatively linear price-distance relationship. Once again the transformations tested produced marginal results and did not improve the fit of the model.

Additional transformations were tested on variables with a priori expected non-linear relationships with the dependent variable such as POP and CPI. Other variables which demonstrated an important relationship with the dependent variable were tested for transformation using the iterative procedure previously described. The transformations tested resulted in marginal improvement in the predictive capability and the fit of the model. The unexplained variance is captured by other effects which are not measured by the data and the variables collected and cannot be explained through transformation of the variables tested.

After transformation testing of the independent variables for a potential better fit to the model an examination of the residuals demonstrated some non-normality. Therefore to smooth out extremes in land prices which detract from the predictive power of the regression equation, analysis is performed on transformations of the dependent variable DOLLAR. The square root of DOLLAR coaxed the relationship to normality and increased the coefficient of multiple determination by approximately 0.03. However, although the square root of DOLLAR appeared to correct for normality in the dependent variable problems may occur with a disruption of the assumption of the normal distribution of the independent variables. Therefore, transformation of the dependent variable was not used in the following tests of alternative model forms.

Prediction of land prices through multiple regression also requires the assumption that factors contributing to land prices are additive and do not produce interaction effects. Interaction occurs when the presence of two characteristics add more or less to the price per acre than the sum of their individual contributions.

A priori expected interaction between various sets of variables such as size, land use, county location, accessibility, road condition and soil classification are formulated and tested. Examination of the data revealed expected interaction between the variables SIZE, LEDUC and URES. All of the expected interaction variables tested had a marginal effect on predictive capability and improvement in the fit of the model.

E. Multicollinearity Problems

The validity of the regression estimates and the statistical criteria are influenced by the empirical data. Therefore, the statistical results of this study are evaluated with respect to economic criteria that test for imperfections in the economic data. The common problem that originates in the data is multicollinearity. It was expected that data collected over time with respect to the land market are likely to be highly correlated due to the influence of economic growth on many of the independent variables.

An examination of the Pearson correlation coefficients confirms the presence of multicollinearity as evidenced by the high correlation coefficients among some of the independent variables. Pearson correlation coefficients are presented in Table 5.8. Specifically, most measures of the level of economic development are highly intercorrelated. The following economic variables are highly intercorrelated: population (POP), population growth rate (GPOP), county taxation rate (TAXP), Alberta wellhead oil

TABLE 5.8
PEARSON CORRELATION COEFFICIENTS

	DOLLAR	ADOLLAR	SALE	SIZE	TIME	POP	CPI	SCBD	SBRY	SAT	THWY
DOLLAR	1.0000 (0) P= .	.9268 (452) P= .000	.8639 (452) P= .000	-.1749 (452) P= .000	.6709 (452) P= .000	.6905 (452) P= .000	.6909 (452) P= .000	-.1083 (452) P= .011	-.1463 (452) P= .001	.0202 (452) P= .334	-.1020 (452) P= .015
ADOLLAR	.9268 (452) P= .000	1.0000 (0) P= .	.7979 (452) P= .000	-.1805 (452) P= .000	.4434 (452) P= .000	.4495 (452) P= .000	.4451 (452) P= .000	-.2329 (452) P= .000	-.2659 (452) P= .000	-.0464 (452) P= .163	-.1477 (452) P= .001
SALE	.8639 (452) P= .000	.7979 (452) P= .000	1.0000 (0) P= .	.2304 (452) P= .000	.5770 (452) P= .000	.5909 (452) P= .000	.5893 (452) P= .000	-.0751 (452) P= .056	-.1113 (452) P= .009	-.0069 (452) P= .442	-.1176 (452) P= .006
SIZE	-.1749 (452) P= .000	-.1805 (452) P= .000	.2304 (452) P= .000	1.0000 (0) P= .	-.1627 (452) P= .000	-.1622 (452) P= .000	-.1605 (452) P= .000	.0793 (452) P= .046	.1064 (452) P= .012	-.0351 (452) P= .228	-.0458 (452) P= .165
TIME	.6709 (452) P= .000	.4434 (452) P= .000	.5770 (452) P= .000	-.1627 (452) P= .000	1.0000 (0) P= .	.9867 (452) P= .000	.9789 (452) P= .000	.1596 (452) P= .000	.0883 (452) P= .030	.1542 (452) P= .001	-.0060 (452) P= .449
POP	.6905 (452) P= .000	.4495 (452) P= .000	.5909 (452) P= .000	-.1622 (452) P= .000	.9867 (452) P= .000	1.0000 (0) P= .	.9966 (452) P= .000	.1480 (452) P= .001	.0878 (452) P= .031	.1550 (452) P= .000	-.0002 (452) P= .498
CPI	.6909 (452) P= .000	.4451 (452) P= .000	.5893 (452) P= .000	-.1605 (452) P= .000	.9789 (452) P= .000	.9966 (452) P= .000	1.0000 (0) P= .	.1360 (452) P= .002	.0812 (452) P= .042	.1523 (452) P= .001	-.0086 (452) P= .428
SCBD	-.1083 (452) P= .011	-.2329 (452) P= .000	-.0751 (452) P= .056	.0793 (452) P= .046	.1596 (452) P= .000	.1480 (452) P= .001	.1360 (452) P= .002	1.0000 (0) P= .	.9302 (452) P= .000	.3703 (452) P= .000	.4454 (452) P= .000
SBRY	-.1463 (452) P= .001	-.2659 (452) P= .000	-.1113 (452) P= .009	.1064 (452) P= .012	.0883 (452) P= .030	.0878 (452) P= .031	.0812 (452) P= .042	.9302 (452) P= .000	1.0000 (0) P= .	.3761 (452) P= .000	.3411 (452) P= .000
SAT	.0202 (452) P= .334	-.0464 (452) P= .163	-.0069 (452) P= .442	-.0351 (452) P= .228	.1542 (452) P= .001	.1550 (452) P= .000	.1523 (452) P= .001	.3703 (452) P= .000	.3761 (452) P= .000	1.0000 (0) P= .	.3201 (452) P= .000
THWY	-.1020 (452) P= .015	-.1477 (452) P= .001	-.1176 (452) P= .006	-.0458 (452) P= .165	-.0060 (452) P= .449	-.0002 (452) P= .498	-.0086 (452) P= .428	.4454 (452) P= .000	.3411 (452) P= .000	.3201 (452) P= .000	1.0000 (0) P= .

TABLE 5.8 (continued):

	DOLLAR	ADOLLAR	SALE	SIZE	TIME	POP	CPI	SCBD	SBRY	SAT	THWY
TCBD	-.0959 (452) P= .021	-.2115 (452) P= .000	-.0789 (452) P= .047	.0444 (452) P= .173	.1572 (452) P= .000	.1505 (452) P= .001	.1394 (452) P= .001	.9210 (452) P= .000	.8392 (452) P= .000	.4903 (452) P= .000	.5666 (452) P= .000
TBRY	-.1073 (452) P= .011	-.2277 (452) P= .000	-.0869 (452) P= .032	.0573 (452) P= .112	.1159 (452) P= .007	.1198 (452) P= .005	.1132 (452) P= .008	.8793 (452) P= .000	.8842 (452) P= .000	.5023 (452) P= .000	.4745 (452) P= .000
TSAT	.0476 (452) P= .156	-.0239 (452) P= .306	.0171 (452) P= .358	-.0191 (452) P= .342	.1620 (452) P= .000	.1702 (452) P= .000	.1666 (452) P= .000	.3768 (452) P= .000	.3717 (452) P= .000	.9099 (452) P= .000	.3306 (452) P= .000
TSC	-.0916 (452) P= .026	-.2095 (452) P= .000	-.0662 (452) P= .080	.0697 (452) P= .069	.1254 (452) P= .004	.1259 (452) P= .004	.1190 (452) P= .006	.8911 (452) P= .000	.8763 (452) P= .000	.4951 (452) P= .000	.5047 (452) P= .000
SBDV	-.1063 (452) P= .012	-.2010 (452) P= .000	-.1095 (452) P= .010	.0517 (452) P= .136	.0870 (452) P= .032	.0826 (452) P= .040	.0796 (452) P= .045	.5940 (452) P= .000	.5843 (452) P= .000	.4572 (452) P= .000	.2122 (452) P= .000
INTRT	.6035 (452) P= .000	.3670 (452) P= .000	.5228 (452) P= .000	-.1375 (452) P= .002	.8402 (452) P= .000	.8688 (452) P= .000	.8666 (452) P= .000	.1587 (452) P= .000	.1351 (452) P= .002	.1580 (452) P= .000	.0402 (452) P= .197
SOIL	-.0026 (452) P= .478	-.0068 (452) P= .442	-.0248 (452) P= .299	-.0381 (452) P= .209	-.0192 (452) P= .342	-.0144 (452) P= .380	-.0126 (452) P= .394	.1211 (452) P= .005	.1063 (452) P= .012	.1795 (452) P= .000	.2701 (452) P= .000
URES	.0512 (452) P= .138	.1226 (452) P= .005	.0588 (452) P= .106	-.0038 (452) P= .468	-.0686 (452) P= 073	-.0706 (452) P= .067	-.0673 (452) P= .077	-.1778 (452) P= .000	-.1618 (452) P= .000	.1054 (452) P= .013	.0220 (452) P= .321
UCOM	-.0195 (452) P= .339	.0403 (452) P= .196	-.0562 (452) P= .117	-.0800 (452) P= .045	-.1031 (452) P= .014	-.0925 (452) P= .025	-.0906 (452) P= .027	-.1351 (452) P= .002	-.1276 (452) P= .003	-.1085 (452) P= .011	-.0992 (452) P= .017
METRO	-.0266 (452) P= .286	.0589 (452) P= .106	-.0391 (452) P= .204	-.0454 (452) P= .168	-.1902 (452) P= .000	-.1703 (452) P= .000	-.1620 (452) P= .000	-.5399 (452) P= .000	-.5412 (452) P= .000	-.3377 (452) P= .000	-.2914 (452) P= .000
DPOP	.1170 (452) P= .006	.1920 (452) P= .000	.1013 (452) P= 016	-.0278 (452) P= .278	-.0726 (452) P= .062	-.0593 (452) P= .104	-.0495 (452) P= .147	-.4156 (452) P= .000	-.3568 (452) P= .000	-.1314 (452) P= .003	-.1536 (452) P= .001

TABLE 5.8 (continued):

	DOLLAR	ADOLLAR	SALE	SIZE	TIME	POP	CPI	SCBD	SBRY	SAT	THWY
ASUB	.0518 (452) P= .136	.1639 (452) P= .000	.0476 (452) P= .156	-.0278 (452) P= .278	-.1437 (452) P= .001	-.1305 (452) P= .003	-.1269 (452) P= .003	-.4437 (452) P= .000	-.4317 (452) P= .000	-.1763 (452) P= .000	-.1346 (452) P= .002
PARK	-.0139 (452) P= .384	.0224 (452) P= .317	-.0280 (452) P= .276	-.0298 (452) P= .264	-.0824 (452) P= .040	-.0682 (452) P= .074	-.0573 (452) P= .112	-.2778 (452) P= .000	-.2442 (452) P= .000	-.0975 (452) P= .019	-.1232 (452) P= .004
LEDUC	.0324 (452) P= .246	.0118 (452) P= .401	.0517 (452) P= .137	.0042 (452) P= .465	.0504 (452) P= .143	.0433 (452) P= .179	.0389 (452) P= .204	.2726 (452) P= .000	.1222 (452) P= .005	.1961 (452) P= .000	.1338 (452) P= .002
SCONA	.0294 (452) P= .267	.0710 (452) P= .066	.0405 (452) P= .195	.0303 (452) P= .260	-.0574 (452) P= .112	- 0521 (452) P= .134	-.0500 (452) P= .144	-.3110 (452) P= .000	-.2620 (452) P= .000	.1192 (452) P= .006	-.0945 (452) P= .022
ROAD	-.0256 (452) P= .294	-.0399 (452) P= .199	.0072 (452) P= .439	.0307 (452) P= .257	-.0028 (452) P= .476	-.0129 (452) P= .392	-.0169 (452) P= .360	.1165 (452) P= .007	.0709 (452) P= .066	.1651 (452) P= .000	.1110 (452) P= .009
URBAN	-.0190 (452) P= .343	.0757 (452) P= .054	-.0562 (452) P= .117	-.0734 (452) P= .060	-.1537 (452) P= .001	-.1382 (452) P= .002	-.1334 (452) P= .002	-.3898 (452) P= .000	-.3805 (452) P= .000	-.2144 (452) P= .000	-.2269 (452) P= .000
ZRES	.0463 (452) P= .163	.0750 (452) P= .056	.0298 (452) P= .263	-.0338 (452) P= .237	-.0349 (452) P= .230	-.0218 (452) P= .322	-.0192 (452) P= .342	-.0413 (452) P= .191	-.0695 (452) P= .070	.2360 (452) P= .000	.1440 (452) P= .001
ZCOM	-.0268 (452) P= .285	.0014 (452) P= .488	-.0451 (452) P= .169	-.0609 (452) P= .098	-.0245 (452) P= .301	-.0215 (452) P= .325	-.0228 (452) P= .314	-.1136 (452) P= .008	-.1191 (452) P= .006	-.1220 (452) P= .005	-.0780 (452) P= .049
TAXP	.5486 (452) P= .000	.3233 (452) P= .000	.4558 (452) P= .000	-.1506 (452) P= .001	.7785 (452) P= .000	.8061 (452) P= .000	.8189 (452) P= .000	.2228 (452) P= .000	.1384 (452) P= .002	.1078 (452) P= .011	.0276 (452) P= .279
RDA	.0502 (452) P= .143	.0558 (452) P= .118	.0423 (452) P= .185	-.0242 (452) P= .304	.0406 (452) P= .195	.0456 (452) P= .167	.0411 (452) P= .192	.0400 (452) P= .198	.0419 (452) P= .187	.0573 (452) P= .112	.0547 (452) P= .123
GPOP	.4772 (452) P= .000	.2896 (452) P= .000	.3984 (452) P= .000	-.0863 (452) P= 033	.5731 (452) P= .000	.6383 (452) P= .000	.6738 (452) P= .000	.0207 (452) P= .330	-.0259 (452) P= .291	.0391 (452) P= .204	-.0440 (452) P= .175

TABLE 5.8 (continued):

	DOLLAR	ADOLLAR	SALE	SIZE	TIME	POP	CPI	SCBD	SBRY	SAT	THWY
TRANS	-.0516 (452) P= .137	-.0485 (452) P= .152	-.0154 (452) P= .372	-.0020 (452) P= .483	.1031 (452) P= .014	.0270 (452) P= .284	.0029 (452) P= .476	.2452 (452) P= .000	.1044 (452) P= .013	.0823 (452) P= .040	.0884 (452) P= .030
XVAL	.3583 (452) P= .000	.2642 (452) P= .000	3300 (452) P= .000	-.0704 (452) P= .068	.5693 (452) P= .000	.5345 (452) P= .000	.5173 (452) P= .000	.0471 (452) P= .159	-.0021 (452) P= .483	.1135 (452) P= .008	-.0372 (452) P= .215
NCR	-.0610 (452) P= .098	-.0093 (452) P= .422	-.0466 (452) P= .161	0284 (452) P= .274	-.1317 (452) P= .003	-.1390 (452) P= .002	-.1420 (452) P= .001	-.2373 (452) P= .000	-.1676 (452) P= .000	-.1036 (452) P= .014	-.1290 (452) P= .003
ACR	.0364 (452) P= .220	.1038 (452) P= .014	.0364 (452) P= .220	-.0107 (452) P= .410	-.0055 (452) P= .453	-.0256 (452) P= .294	-.0306 (452) P= .258	-.2895 (452) P= .000	-.2592 (452) P= .000	-.0481 (452) P= .154	-.1475 (452) P= .001
OPEC	.6828 (452) P= .000	.4365 (452) P= .000	.5787 (452) P= .000	-.1602 (452) P= .000	.9685 (452) P= .000	.9864 (452) P= .000	.9953 (452) P= .000	.1263 (452) P= .004	.0686 (452) P= .073	.1512 (452) P= .001	-.0142 (452) P= .382

TABLE 5.8 (continued):

	TCBD	TBRY	TSAT	TSC	SBDV	INTRT	SOIL	URES	UCOM	METRO	DPOP
TCBD	1.0000 (0) P= .	.9324 (452) P= .000	.5142 (452) P= .000	.9415 (452) P= .000	.6051 (452) P= .000	.1531 (452) P= .001	.1098 (452) P= .010	-.1510 (452) P= .001	-.1480 (452) P= .001	-.5374 (452) P= .000	-.3863 (452) P= .000
TBRY	.9324 (452) P= .000	1.0000 (0) P= .	.5249 (452) P= .000	.9686 (452) P= 000	.6063 (452) P= .000	.1486 (452) P= .001	.0909 (452) P= .027	-.1754 (452) P= .000	-.1312 (452) P= .003	-.5637 (452) P= .000	-.3457 (452) P= .000
TSAT	.5142 (452) P= .000	.5249 (452) P= .000	1.0000 (0) P= .	.5219 (452) P= .000	.4627 (452) P= .000	.1597 (452) P= .000	.1730 (452) P= .000	.1041 (452) P= .013	-.0952 (452) P= .022	-.3411 (452) P= .000	-.0988 (452) P= .018
TSC	.9415 (452) P= .000	.9686 (452) P= .000	.5219 (452) P= .000	1.0000 (0) P=	.5921 (452) P= .000	.1495 (452) P= .001	1113 (452) P= .009	-.1670 (452) P= .000	-.1133 (452) P= .008	-.5515 (452) P= .000	-.3585 (452) P= .000
SBDV	.6051 (452) P= .000	.6063 (452) P= .000	.4627 (452) P= .000	.5921 (452) P= .000	1.0000 (0) P= .	.0957 (452) P= .021	-.0074 (452) P= .437	-.2483 (452) P= .000	-.0644 (452) P= .086	-.3142 (452) P= .000	-.2682 (452) P= .000
INTRT	.1531 (452) P= .001	.1486 (452) P= .001	.1597 (452) P= .000	.1495 (452) P= .001	.0957 (452) P= .021	1.0000 (0) P= .	-.0076 (452) P= .436	-.0661 (452) P= .080	-.0844 (452) P= .036	-.1801 (452) P= .000	-.0544 (452) P= .124
SOIL	.1098 (452) P= .010	.0909 (452) P= .027	.1730 (452) P= .000	.1113 (452) P= .009	-.0074 (452) P= .437	-.0076 (452) P= .436	1.0000 (0) P= .	.2997 (452) P= .000	-.0781 (452) P= .049	-.0665 (452) P= .079	.0861 (452) P= .034
URES	-.1510 (452) P= .001	-.1754 (452) P= .000	.1041 (452) P= .013	-.1670 (452) P= .000	-.2483 (452) P= .000	-.0661 (452) P= .080	.2997 (452) P= .000	1.0000 (0) P= .	-.0320 (452) P= .249	.0245 (452) P= .302	.3730 (452) P= .000
UCOM	-.1480 (452) P= .001	-.1312 (452) P= .003	-.0952 (452) P= .022	-.1133 (452) P= .008	-.0644 (452) P= .086	-.0844 (452) P= .036	-.0781 (452) P= .049	-.0320 (452) P= .249	1.0000 (0) P= .	.1595 (452) P= .000	-.0103 (452) P= .413
METRO	-.5374 (452) P= .000	-.5637 (452) P= .000	-.3411 (452) P= .000	-.5515 (452) P= .000	-.3142 (452) P= .000	-.1801 (452) P= .000	-.0665 (452) P= .079	0245 (452) P= .302	.1595 (452) P= .000	1.0000 (0) P= .	.3047 (452) P= .000
DPOP	-.3863 (452) P= .000	-.3457 (452) P= .000	-.0988 (452) P= .018	-.3585 (452) P= .000	-.2682 (452) P= .000	-.0544 (452) P= .124	.0861 (452) P= .034	.3730 (452) P= 000	-.0103 (452) P= .413	.3047 (452) P= .000	1.0000 (0) P= .

TABLE 5.8 (continued):

	TCBD	TBRY	TSAT	TSC	SBDV	INTRT	SOIL	URES	UCOM	METRO	DPOP
ASUB	-.4094 (452) P= .000	-.4293 (452) P= .000	-.1566 (452) P= .000	-.4239 (452) P= .000	-.5267 (452) P= .000	-.1560 (452) P= .000	.1865 (452) P= .000	.4514 (452) P= .000	.0647 (452) P= .085	.2907 (452) P= .000	.3735 (452) P= .000
PARK	-.2115 (452) P= .000	-.2345 (452) P= .000	-.1273 (452) P= .003	-.2403 (452) P= .000	-.2258 (452) P= .000	-.0510 (452) P= .140	0729 (452) P= .061	.1306 (452) P= .003	-.0255 (452) P= .295	.2050 (452) P= .000	.0848 (452) P= .036
LEDUC	.3831 (452) P= .000	.2982 (452) P= .000	.2136 (452) P= .000	.3374 (452) P= .000	.2548 (452) P= .000	.0168 (452) P= .361	- 0545 (452) P= .124	-.1680 (452) P= .000	.0030 (452) P= .475	.0148 (452) P= .377	-.1909 (452) P= .000
SCONA	-.2954 (452) P= .000	-.2425 (452) P= .000	.1627 (452) P= .000	-.2975 (452) P= .000	-.2486 (452) P= .000	-.0671 (452) P= .077	.0613 (452) P= .097	.2799 (452) P= .000	.0335 (452) P= .239	.1480 (452) P= .001	.3792 (452) P= .000
ROAD	.1773 (452) P= .000	.1475 (452) P= .001	.1869 (452) P= .000	.1482 (452) P= .001	.1712 (452) P= .000	-.0420 (452) P= .187	.0632 (452) P= .090	-.0090 (452) P= .424	-.1548 (452) P= .000	-.1752 (452) P= .000	-.1384 (452) P= .002
URBAN	-.4306 (452) P= .000	-.4199 (452) P= .000	-.2365 (452) P= .000	-.4211 (452) P= .000	-.2290 (452) P= .000	-.1530 (452) P= .001	-.0056 (452) P= .453	-.0023 (452) P= .481	.1527 (452) P= .001	.5667 (452) P= .000	.2422 (452) P= .000
ZRES	-.0101 (452) P= .415	-.0393 (452) P= .202	.2247 (452) P= .000	-.0355 (452) P= .226	-.1566 (452) P= .000	-.0004 (452) P= .497	.4626 (452) P= .000	.5247 (452) P= .000	-.0579 (452) P= .110	.0069 (452) P= .442	.2333 (452) P= .000
ZCOM	-.1401 (452) P= .001	-.1410 (452) P= .001	-.1166 (452) P= .007	-.1284 (452) P= .003	-.0786 (452) P= .047	-.0075 (452) P= .437	.0323 (452) P= .246	-.0558 (452) P= .118	.5735 (452) P= .000	.2001 (452) P= .000	-.0233 (452) P= .311
TAXP	.2362 (452) P= .000	.1794 (452) P= .000	.1046 (452) P= .013	.2118 (452) P= .000	.1726 (452) P= .000	.7072 (452) P= .000	-.0280 (452) P= .276	-.1092 (452) P= .010	-.0667 (452) P= .078	-.1385 (452) P= .002	-.1237 (452) P= .004
RDA	.0550 (452) P= .122	.0670 (452) P= .078	.0602 (452) P= .101	.0567 (452) P= .114	.0734 (452) P= .059	.0136 (452) P= .386	.1524 (452) P= .001	-.0597 (452) P= .103	.0818 (452) P= .041	.0657 (452) P= .081	-.0717 (452) P= .064
GPOP	.0329 (452) P= .243	.0063 (452) P= .447	.0657 (452) P= .082	.0179 (452) P= .352	.0067 (452) P= 444	.4328 (452) P= 000	.0322 (452) P= .247	.0018 (452) P= .485	-.0154 (452) P= .372	-.0378 (452) P= .212	.0005 (452) P= .496

TABLE 5.8 (continued):

	TCBD	TBRY	TSAT	TSC	SBDV	INTRT	SOIL	URES	UCOM	METRO	DPOP
TRANS	.3054 (452) P= .000	.1951 (452) P= .000	.0703 (452) P= .068	.2380 (452) P= .000	.2264 (452) P= .000	.0517 (452) P= .136	-.0690 (452) P= .071	-.1268 (452) P= .003	-.0727 (452) P= .061	-.0861 (452) P= .034	-.2611 (452) P= .000
XVAL	.0097 (452) P= .419	-.0391 (452) P= .204	.1280 (452) P= .003	-.0620 (452) P= .094	-.0344 (452) P= .233	.4901 (452) P= .000	.0030 (452) P= .475	.0582 (452) P= .109	-.0668 (452) P= .078	-.1860 (452) P= .000	-.0074 (452) P= .437
NCR	-.2459 (452) P= .000	-.2095 (452) P= .000	-.0751 (452) P= .055	-.2559 (452) P= .000	-.1759 (452) P= .000	-.1281 (452) P= .003	.0113 (452) P= .406	.1088 (452) P= .010	-.0450 (452) P= .170	.0288 (452) P= .271	.1548 (452) P= .000
ACR	-.2660 (452) P= .000	-.2488 (452) P= .000	-.0245 (452) P= .302	-.3167 (452) P= .000	-.2172 (452) P= .000	-.0531 (452) P= .130	-.0032 (452) P= .473	.1229 (452) P= .004	-.0371 (452) P= .216	.0878 (452) P= .031	.2010 (452) P= .000
OPEC	.1311 (452) P= .003	.1015 (452) P= .015	.1635 (452) P= .000	.1077 (452) P= .011	.0779 (452) P= .049	.8478 (452) P= .000	-.0093 (452) P= .422	-.0561 (452) P= .117	-.0915 (452) P= .026	-.1558 (452) P= .000	-.0433 (452) P= .179

TABLE 5.8 (continued):

	ASUB	PARK	LEDUC	SCONA	ROAD	URBAN	ZRES	ZCOM	TAXP	RDA	GPOP
ASUB	1.0000 (0) P= .	.2352 (452) P= .000	-.1795 (452) P= .000	.2870 (452) P= .000	-.1405 (452) P= .001	.2875 (452) P= .000	.3698 (452) P= .000	.0783 (452) P= .048	-.1847 (452) P= .000	.0000 (452) P= .500	-.0191 (452) P= .343
PARK	.2352 (452) P= .000	1.0000 (0) P= .	-.2120 (452) P= .000	-.1445 (452) P= .001	.0068 (452) P= .443	.1270 (452) P= .003	.0931 (452) P= .024	-.0444 (452) P= .173	-.0031 (452) P= .473	-.0575 (452) P= .111	.0470 (452) P= .159
LEDUC	-.1795 (452) P= .000	-.2120 (452) P= .000	1.0000 (0) P= .	-.3155 (452) P= .000	.1168 (452) P= .006	-.0559 (452) P= .118	.0124 (452) P= .396	.0393 (452) P= .203	.3071 (452) P= .000	.1382 (452) P= .002	-.0163 (452) P= .365
SCONA	.2870 (452) P= .000	-.1445 (452) P= .001	-.3155 (452) P= .000	1.0000 (0) P= .	-.0037 (452) P= .468	.1315 (452) P= .003	.2123 (452) P= .000	.0999 (452) P= .017	-.3339 (452) P= .000	-.1079 (452) P= .011	-.0367 (452) P= .218
ROAD	-.1405 (452) P= .001	.0068 (452) P= .443	.1168 (452) P= .006	-.0037 (452) P= .468	1.0000 (0) P= .	-.1773 (452) P= .000	-.0353 (452) P= .227	-.0619 (452) P= .094	-.0009 (452) P= .492	-.0237 (452) P= .307	-.0127 (452) P= .394
URBAN	.2875 (452) P= .000	.1270 (452) P= .003	-.0559 (452) P= .118	.1315 (452) P= .003	-.1773 (452) P= .000	1.0000 (0) P= .	.0408 (452) P= .193	.2139 (452) P= .000	-.1137 (452) P= .008	.1024 (452) P= .015	-.0478 (452) P= .155
ZRES	.3698 (452) P= .000	.0931 (452) P= .024	.0124 (452) P= .396	.2123 (452) P= .000	-.0353 (452) P= .227	.0408 (452) P= .193	1.0000 (0) P= .	-.1010 (452) P= .016	-.0233 (452) P= .311	-.0004 (452) P= .496	.0054 (452) P= .454
ZCOM	.0783 (452) P= .048	-.0444 (452) P= .173	.0393 (452) P= .203	.0999 (452) P= .017	-.0619 (452) P= .094	.2139 (452) P= .000	-.1010 (452) P= .016	1.0000 (0) P= .	-.0502 (452) P= .143	.0818 (452) P= .041	-.0379 (452) P= .211
TAXP	-.1847 (452) P= .000	-.0031 (452) P= .473	.3071 (452) P= .000	-.3339 (452) P= .000	-.0009 (452) P= .492	-.1137 (452) P= .008	-.0233 (452) P= .311	-.0502 (452) P= .143	1.0000 (0) P= .	.0553 (452) P= .120	.6465 (452) P= .000
RDA	.0000 (452) P= .500	-.0575 (452) P= .111	.1382 (452) P= .002	-.1079 (452) P= .011	-.0237 (452) P= .307	.1024 (452) P= .015	-.0004 (452) P= .496	.0818 (452) P= .041	.0553 (452) P= .120	1.0000 (0) P= .	.0064 (452) P= .446
GPOP	-.0191 (452) P= .343	.0470 (452) P= .159	-.0163 (452) P= .365	-.0367 (452) P= .218	-.0127 (452) P= .394	-.0478 (452) P= .155	.0054 (452) P= .454	-.0379 (452) P= .211	.6465 (452) P= .000	.0064 (452) P= .446	1.0000 (0) P= .

TABLE 5.8 (continued):

	ASUB	PARK	LEDUC	SCONA	ROAD	URBAN	ZRES	ZCOM	TAXP	RDA	GPOP
TRANS	-.1770 (452) P= .000	.0242 (452) P= .304	.6412 (452) P= .000	-.5317 (452) P= .000	.0723 (452) P= .062	-.1136 (452) P= .008	-.0663 (452) P= .080	-.0222 (452) P= .319	.2093 (452) P= .000	.1086 (452) P= .010	-.2717 (452) P= .000
XVAL	-.0348 (452) P= .230	-.1789 (452) P= .000	-.2432 (452) P= .000	.3556 (452) P= .000	.0113 (452) P= .405	-.1408 (452) P= .001	.0167 (452) P= .362	.0089 (452) P= .425	.2361 (452) P= .000	-.0311 (452) P= .255	.1620 (452) P= .000
NCR	.1552 (452) P= .000	.1973 (452) P= .000	-.5328 (452) P= .000	.3040 (452) P= .000	.0233 (452) P= .311	-.0212 (452) P= .327	.0548 (452) P= .123	-.0556 (452) P= .119	-.3517 (452) P= .000	-.1275 (452) P= .003	-.0780 (452) P= .049
ACR	.1748 (452) P= .000	.3090 (452) P= .000	-.4702 (452) P= .000	.4176 (452) P= .000	-.0082 (452) P= .431	.0094 (452) P= .421	.0911 (452) P= .026	-.0415 (452) P= .190	-.3286 (452) P= .000	-.1149 (452) P= .007	-.1206 (452) P= .005
OPEC	-.1212 (452) P= .005	-.0484 (452) P= .152	.0394 (452) P= .202	-.0487 (452) P= .151	-.0164 (452) P= .364	-.1296 (452) P= 003	-.0134 (452) P= .388	-.0243 (452) P= .303	.8289 (452) P= .000	.0375 (452) P= .213	.7034 (452) P= .000

TABLE 5.8 (continued):

	TRANS	XVAL	NCR	ACR	OPEC
TRANS	1.0000	-.0806	-.3057	-.2794	-.0039
	(0)	(452)	(452)	(452)	(452)
	P= .	P= .043	P= .000	P= .000	P= .467
XVAL	-.0806	1.0000	.1862	.3231	.5099
	(452)	(0)	(452)	(452)	(452)
	P= .043	P= .	P= .000	P= .000	P= .000
NCR	-.3057	.1862	1.0000	.6775	-.1550
	(452)	(452)	(0)	(452)	(452)
	P= .000	P= .000	P= .	P= .000	P= .000
ACR	-.2794	.3231	.6775	1.0000	-.0294
	(452)	(452)	(452)	(0)	(452)
	P= .000	P= .000	P= .000	P= .	P= .266
OPEC	-.0039	.5099	-.1550	-.0294	1.0000
	(452)	(452)	(452)	(452)	(0)
	P= .467	P= .000	P= .000	P= .266	P= .

price (OPEC) , consumer price index (CPI) and prime interest rate (INTRT). In addition, a number of the accessibility measures demonstrate high levels of correlation. The following accessibility variables are highly intercorrelated: straightline distance to Edmonton CBD (SCBD), travel distance to Edmonton CBD (TCBD), straightline distance to Edmonton boundary (SBRY), travel distance to Edmonton boundary (TBRY) and travel distance to nearest regional shopping center (TSC). In addition, straightline distance (SAT) and travel distance (TSAT) to the nearest satellite town demonstrate a high level of intercorrelation.

Factor analysis is applied in this study with the objective of reducing redundancy among variables and to identify a smaller number of underlying factors. Factor analysis reduces a larger number of variables, many of which may be highly correlated, into a smaller number of underlying factors. By isolating these major dimensions, factor analysis provides information that is useful in reducing redundancy among variables. To the extent that redundant, highly correlated variables are excluded, multicollinearity is reduced.

Factor analysis is performed on all of the independent variables in the data set. Once each of the factors has been isolated each independent variable is assigned to one of the factor groups. Each variable is assigned to the factor upon which it has the largest absolute factor loading (i.e. the factor to which it was most correlated). This procedure results in each variable being classified as belonging to only one factor group. Next, when regression analysis is performed only one variable assigned to each factor group is allowed to enter the regression process. Therefore, a variable entering the regression analysis from one factor will preclude any other variable entering from that same factor.

Because only one variable per factor dimension is entered, and because the variables on each factor tend to be highly correlated with each other, this procedure systematically reduces the probability that highly correlated variables are included in the final regression model. Variables are allowed to continue entering the regression procedure as long as they are all on separate factors and as long as they are significant at the 0.10 level. This procedure produces a regression model in which each variable is both statistically significant and representative of a different dimension in the original data.

F. Factor Analysis Results

Factor analyis is used to identify and simplify the dependence structure of the independent variables. Initially it was assumed that the variables specified in the general land price predictor model included the total variation among all economic, spatial, site, institutional and market characteristics. The hypothesis of the specified set of latent factors representing these characteristics is tested for validity.

The variables are transformed to standard scores and are used for input into the SPSSX Factor Analysis Program. The diagonal elements of the computed correlation matrix were unchanged, thus the factors derived are linear transformations of the original variables and contain the sum of the original variance.

To facilitate interpretation of the factors, orthogonal transformations or rotations are applied to the factors. Varimax rotation is used to simplify the pattern of loadings on the factors rather than on the variables. This technique attempts to define the factor axes in a unique manner which maximizes the loadings on as few variables as possible and minimizes the loadings on the remainder of the variables for each factor. Since the factors are orthogonal transformations of the input correlation matrix, a non-deterministic orthogonal rotation will maintain this property.

The first nine factors, which account for 74.3 percent of the variance, are presented in Table 5.9. The first factor extracted explains the largest portion of the total variation among the variables. With that portion removed from the total variation, the second factor accounts for the largest portion of the remainder. Factors are created in this manner until the total variation is accounted for

TABLE 5.9
FACTOR ANALYSIS RESULTS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9
SCBD	.92017								
SBRY	.91493								
TSC	.91143								
TBRY	.90800								
TCBD	.90069								
METRO	-.66097								
THWY	.56813								
SBDV	.55320								
URBAN	-.50577								.50541
DPOP									
OPEC		.98461							
POP		.98057							
TIME		.96367							
INTRT		.87431							
TAXP		.84593							
GPOP		.69127							
XVAL		.55530							
ACR			.84688						
NCR			.79567						
LEDUC			-.67122						
ZRES				.80050					
URES				.76547					
SOIL				.64462					
ASUB				.61538					
TSAT					.82633				
SAT					.81312				
ZCOM						.86297			
UCOM						.85580			
SIZE									
TRANS							.84762		
PARK								.79722	
SCONA								-.51717	
RDA									.73903
ROAD									

among as many factors as there are input variables. Factors beyond the first nine, using an eigenvalue of "one" criteria, were deemed to account for so little non-error variation that they were excluded from interpretation.

To assist in the identification and interpretation of the resulting factors, the rotated factor pattern matrix, presented in Table 5.9, is sorted in declining order with variables having high loadings on the same factor appearing together. Loadings of less than 0.5 in absolute value have been deleted from the table to facilitate interpretation. The entire rotated factor matrix is presented in Appendix A.

The first factor explains approximately 23.9 percent of the variation in the original data and may be interpreted as an index to represent urban accessibility. The second factor explains an additional 14.4 percent of the variation in the data and may be identified as an index to represent economic growth indicator variables. Assuming that all variation among economic, spatial, site, institutional and market characteristics is included in the variables specified in the general model the first nine factors are selected to represent the many general sources of variation found in the original data. After varimax rotation the factors selected are interpreted along with the percent of variation explained as representing the following dimensions:

1. An index of urban accessibility, 23.9 percent.

2. A measure of economic growth, 14.4 percent.
3. An index of country residential subdivision activity, 9.3 percent.
4. A measure of residential use potential, 6.7 percent.
5. An index of satellite town accessibility, 5.0 percent.
6. A measure of commercial use potential, 4.1 percent,
7. A land market activity index, 3.7 percent.
8. A county location indicator, 3.4 percent.
9. An indicator of location in a restrictive development area, 2.9 percent.

The linear functions defined by these factors are used next to construct component scores for use in regression analysis.

G. Results of Regression on Factor Scores

Composite scales or factor scores, which represent the theoretical dimensions of each factor in the rotated components solution (Table 5.9), are derived for input into regression analysis. Nine uncorrelated variables, the factor scores, are regressed against DOLLAR, ADOLLAR and SALE as the dependent variables. Three factors are significant and together explain 52 percent of the variation of land price per acre with DOLLAR as the dependent variable and 30 percent of the variation of the

CPI adjusted price per acre with ADOLLAR as the dependent variable. Five factors are significant and together explain 38 percent of the variation of the total sale price with SALE as the dependent variable. Table 5.10 presents the results of regression on factor scores.

Regression on the factor scores does not provide improvement over the full list of variables collected. This type of analysis is most useful when the set of independent variables is highly correlated and the factor scores derived would satisfy the regression requirement of uncorrelated independent variables. However, due to the dominance of a number of factors and the correlation structure of the variables, the main contribution of the factor analysis procedure is to provide insights as to the underlying structure of relationships among the independent variables.

The significant factor dimensions identified through regression analysis on factor scores confirm the important land price indicators summarized in Chapter III, Table 3.1, "Summary Survey of Expert Opinion". The regression analysis on factor scores identified five significant dimensions: Economic Growth Index, Urban Accessibility Index, a Measure of Residential Use Potential, a Measure of Commercial Use Potential and a County Location Index. These dimensions are identical to those identified by developers as important factors in the decision to purchase land in an urban-rural fringe for potential future development.

TABLE 5.10
RESULTS OF REGRESSION ON FACTOR SCORES

DEPENDENT VARIABLE	DOLLAR	ADOLLAR	SALE
CONSTANT	576.92 (.0000)	7.99 (.0000)	74890.00 (.0000)
FACTOR 2 - ECONOMIC GROWTH INDICATOR	336.32 (.0000)	2.47 (.0000)	39803.28 (.0000)
FACTOR 1 - URBAN ACCESSIBILITY INDEX	-77.97 (.0000)	-1.44 (.0000)	-9160.81 (.0004)
FACTOR 4 - RESIDENTIAL USE POTENTIAL	35.04 (.0268)	0.66 (.0019)	3487.63 (.1716)
FACTOR 8 - COUNTY LOCATION (PARK/SCONA)			-7950.44 (.0019)
FACTOR 6 - COMMERCIAL USE POTENTIAL			-6745.34 (.0084)
R^2	0.519	0.300	0.382
ADJ. R^2	0.516	0.295	0.375
F-STATISTIC	161.39 (.0000)	63.99 (.0000)	55.15 (.0000)

NOTES:

1. Significant t presented in parenthesis (p-value).
2. Full regression models:
   DOLLAR = 576.92 -77.97 FAC1 +336.32 FAC2 -1.93 FAC3 +35.04 FAC4 +7.47 FAC5 -2.32 FAC6 -4.85 FAC7 -13.67 FAC8 -0.15 FAC9
   ADOLLAR = 7.99 -1.45 FAC1 +2.47 FAC2 +0.14 FAC3 +0.67 FAC4 +0.02 FAC5 +0.15 FAC6 +0.19 FAC7 -0.18 FAC8 +0.08 FAC9
   SALE = 74890.00 -9160.81 FAC1 +39803.28 FAC2 -1159.32 FAC3 +3487.63 FAC4 -2318.61 FAC5 -6745.34 FAC6 +180.57 FAC7 -7950.44 FAC8 -3146.63 FAC9.

The signs of the coefficients for the significant factor score variables are as expected. The Urban Accessibility Index coefficient is negative. Both the Economic Growth Index and the Measure of Residential Use Potential are positive. The negative coefficient for Commercial/Industrial Use Potential reflects the practice of using lower priced land for industrial purposes. The negative coefficient for the County Location Index, Parkland or Strathcona, is an indication of comparatively lower land prices which are characteristic of the land market in these counties, due to increased regulatory requirements, difficulty in obtaining development approval, problems of subdividing land for country residential use, increased costs of servicing land and costs of providing infrastructure in these counties.

Factor analyis is used to determine the basic dimensions of the independent variables. Nine factors, accounting for approximately 74.3 percent of the variation, were derived by factor analysis. A reduced model form is estimated next by assigning only one variable to represent each factor group.

H. Reduced Model Forms

A number of reduced variable model forms are now specified and estimated. Reduced variable models are formed by selecting variables identified through factor analysis and by selecting variables to represent each general model classification. The variables are selected based on highest levels of correlation with the dependent variable.

In some instances a proxy variable is selected to represent the combined effect of other variables and as an indicator to represent variables that may be difficult or costly to measure and collect. Precise measures of variables are selected in preference to variables which may include a subjective factor. For an example, straightline distance measures are determined to be more precise and not subject to the variability of travel route decisions. Therefore, straightline measures and are used in place of travel distance measures where equally high levels of intercorrelation exists. The results of reduced variable model testing are presented in this section.

Factor Analysis Based Reduced Models

Factor analysis is used as a data reduction technique, a screening device to reduce multicollinearity and a technique to group highly correlated variables. Only one variable per factor is selected to represent each factor group for use in regression analysis. Highly correlated variables are therefore less likely to enter the regression model than would be the case without factor analysis screening.

The forms of the reduced variable models with one variable selected to represent each factor group are specified for estimation as follows:

DOLLAR = f(SBRY, POP, LEDUC, ASUB, TSAT, SIZE, TRANS, SCONA, RDA)

ADOLLAR = f(SBRY, POP, LEDUC, ASUB, TSAT, SIZE, TRANS, SCONA, RDA)

SALE = f(SBRY, POP, LEDUC, ASUB, TSAT, SIZE, TRANS, SCONA, RDA)

The regression results of the reduced variable model with variables selected to represent each factor group are presented in Table 5.11. Table 5.12 and Table 5.13 for the dependent variables DOLLAR, ADOLLAR , and SALE respectively. The factor analysis based reduced variable models with DOLLAR, ADOLLAR and SALE as the dependent variables account for 53 percent, 32 percent and 51 percent of the variance for each dependent variable respectively. These results compare favorably with the results obtained using the unconstrained full variable regression model. Analysis of results of the factor analysis based reduced variable model with DOLLAR, ADOLLAR and SALE as the dependent variables follows.

(i) Analysis of Results with DOLLAR as Dependent Variable

The regression results for the factor analysis based reduced variable model with DOLLAR as the dependent variable are presented in Table 5.11. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.53. Adjusted R^2 is also 0.53. The standard error of the estimate is $331.88 with an average (mean) predicted price of $576.92 per acre. The standard error of the estimate is approximately 57 percent of the mean. These results are almost identical to the results obtained using the full variable model.

With DOLLAR as the dependent variable five independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP), straightline distance to Edmonton city boundary (SBRY), location within one mile of the nearest approved subdivision (ASUB), location in the County of Leduc (LEDUC), and number of acres transferred by County and year of sale (TRANS). All other variables were not significant at least at the 0.10 level.

The coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

TABLE 5.11
REDUCED MODEL WITH VARIABLES SELECTED REPRESENTING FACTOR GROUPS WITH DOLLAR AS DEPENDENT VARIABLE

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
RDA	38.369	0.021	0.630	0.2696
ASUB	72.611	0.069	1.871	0.0310
SIZE	-0.342	-0.039	-1.157	0.1239
TSAT	-0.463	-0.005	-0.139	0.4450
TRANS	-0.003	-0.125	-2.620	0.0046
POP	5.417	0.706	20.988	0.0000
SBRY	-14.027	-0.181	-4.470	0.0000
SCONA	-37.838	-0.030	-0.694	0.2442
LEDUC	109.275	0.106	2.422	0.0079
CONSTANT	-2390.560		-13.445	0.0000
F-TEST	56.371			0.0000
R^2	0.534			
ADJ. R^2	0.525			
STD. ERROR	331.875			

The beta coefficients presented in Table 5.11 indicate that POP, SBRY, TRANS and LEDUC are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. POP is the single most important variable. The correlation coefficient between DOLLAR and POP is 0.69. Holding all other variables constant, land price per acre, DOLLAR, increased by $5.42 for each increase of 1000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is highly significant and conforms to the theoretical direction. Land price per acre, DOLLAR, is decreased by $14.03 for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

The positive coefficient for ASUB conforms to the expected direction due to future potential use for residential development. The average price per acre is increased by $72.61 for location adjacent to an approved residential subdivision.

Location in the County of Leduc is significant and holding all other variables constant, increased the intercept price by $109.28 per acre. Higher land prices, again are the result of high levels of industrial activity, energy related business and prominent transportation systems. Although the coefficient for the County of Strathcona is not significant at least at the 0.10 level, the results conform with previous findings. Location in the County of Strathcona has a negative influence on land prices.

The negative coefficient for TRANS is again considered an indicator of satisfied demand.

(ii) Analysis of Results with ADOLLAR as Dependent Variable

The regression results for the factor analysis based reduced variable model with ADOLLAR as the dependent variable are presented in Table 5.12. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.32. Adjusted R^2 is 0.31. The standard error of the estimate is $446.50 with an average (mean) predicted price of $799.10 per acre. The standard error of the estimate is 56 percent of the mean. The standard error of $446.50 for the ADOLLAR model is higher than the standard error of $331.88 for the DOLLAR model. This difference in standard errors is compatable with the results in the full variable model.

With ADOLLAR as the dependent variable six independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: size of parcel (SIZE), Metropolitan Edmonton population (POP), straightline distance to Edmonton city boundary (SBRY), location within one mile of the nearest approved

TABLE 5.12
REDUCED MODEL WITH VARIABLES SELECTED REPRESENTING FACTOR GROUPS WITH ADOLLAR AS DEPENDENT VARIABLE

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
RDA	0.798	0.039	0.974	0.1654
ASUB	1.375	0.118	2.632	0.0044
SIZE	-0.007	-0.073	-1.814	0.0352
TSAT	-0.006	-0.006	-0.134	0.4467
TRANS	-0.00002	-0.081	-1.394	0.0820
POP	0.040	0.472	11.601	0.0000
SBRY	-0.219	-0.253	-5.177	0.0000
SCONA	-0.174	-0.012	-0.237	0.4063
LEDUC	1.007	0.088	1.659	0.0489
CONSTANT	-12.172		-5.088	0.0000
F-TEST	22.967			0.0000
R^2	0.319			
ADJ. R^2	0.305			
STD. ERROR	4.465			

subdivision (ASUB), location in the County of Leduc (LEDUC), and number of acres transferred by County and year of sale (TRANS). All other variables were not significant at least at the 0.10 level.

The coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

The beta coefficients presented in Table 5.12 indicate that POP, SBRY, and ASUB are the most important variables in explaining variation in the dependent variable ADOLLAR, adjusted land price per acre. POP is again the single most important variable. The correlation coefficient between POP and ADOLLAR is 0.45. Holding all other variables constant, adjusted land price per acre increased by $4.00 for each increase of 1000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is highly significant and conforms to the theoretical direction. Adjusted land price per acre, ADOLLAR, is decreased by $21.90 per acre for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

The positive coefficient for ASUB conforms to the expected direction due to future potential use for residential development. The average price per acre is increased by $137.50 for location adjacent to an approved residential subdivision.

Location in the County of Leduc is significant and holding all other variables constant, increased the intercept price by $100.70 per acre. Higher land prices in the County of Leduc continue to result from high levels of industrial activity, energy related business and prominent transportation systems. The coefficient for the County of Strathcona is again not significant at the 0.10 level but continues to demonstrate a negative influence on land prices.

The negative coefficient for TRANS is again considered an indicator of satisfied demand.

The SIZE of land parcel in acres of the transaction was theorized to decrease the average price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. SIZE is significant at the 0.035 level. The -0.70 regression coefficient indicates that the price per acre of an average parcel decreases $0.70 per acre for each additional acre of land in the parcel.

(iii) Analysis of Results with SALE as Dependent Variable

The regression results for the factor analysis based reduced variable model with SALE as the dependent variable are presented in Table 5.13. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.51. Adjusted R^2 is 0.50. The standard error of the estimate is $48312.65 with an average (mean) predicted price of $74890.00. The standard error of the estimate is 65 percent of the mean. These results are comparable with the results in the full variable model.

With SALE as the dependent variable six independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP), size of parcel (SIZE), straightline distance to Edmonton city boundary (SBRY), location within one mile of the nearest approved subdivision (ASUB), location in the County of Leduc (LEDUC), and number of acres transferred by county and year of sale (TRANS). All other variables were not significant at least at the 0.10 level.

The coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

The beta coefficients presented in Table 5.13 indicate that POP, SIZE and SBRY are the most important variables in

TABLE 5.13
REDUCED MODEL WITH VARIABLES SELECTED REPRESENTING FACTOR GROUPS WITH SALE AS DEPENDENT VARIABLE

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
RDA	6045.661	0.023	0.681	0.2479
ASUB	10742.074	0.072	1.900	0.0290
SIZE	453.003	0.359	10.538	0.0000
TSAT	-445.954	-0.037	-0.917	0.1798
TRANS	-0.222	-0.065	-1.329	0.0925
POP	736.993	0.676	19.614	0.0000
SBRY	-1865.268	-0.169	-4.083	0.0001
SCONA	1095.256	0.006	0.138	0.4452
LEDUC	15111.908	0.103	2.301	0.0109
CONSTANT	-403053.923		-15.571	0.0000
F-TEST	51.428			0.0000
R^2	0.512			
ADJ. R^2	0.503			
STD. ERROR	48312.646			

explaining variation in the dependent variable SALE, total sale price. POP continues to be the single most important variable. The correlation coefficient between POP and SALE is 0.59. Holding all other variables constant, total sale price increased by $736.99 for each increase of 1000 in population for Metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Parcel SIZE exhibited a direct relationship to total sale price, SALE, and was highly significant. On the average total sale price increases by $453.00 for each additional acre of land in the parcel.

Straightline distance to Edmonton city boundary (SBRY) is highly significant and conforms to the theoretical direction. Total sale price is decreased by $1865.27 for each additional mile in staightline distance that the parcel is located from the Edmonton city boundary.

Location in the County of Leduc is significant at the 0.0109 level and continues to demonstrate higher land prices for parcels located in this county. Holding all other variables constant, total land price increased the intercept price by $15111.91 for parcels located in the County of Leduc. These higher land prices resulted from high levels of industrial activity, energy related business and prominent transportation systems in this county.

The positive coefficient for ASUB conforms to the expected direction due to future potential use for residential development. Total sale price is increased by $10742.07 for location within one mile of an approved residential subdivision. The negative coefficient for TRANS is again considered an indication of satisfied demand.

General Model Classification Based Reduced Models

The general model classification of variables is the basis for the selection of one variable to represent each variable classification group. Variables are classified into groups to represent economic, spatial, site, institutional and market characteristics. One variable is selected to represent each variable classification group based on highest levels of correlation with the dependent variable, precision in measurement and data collection difficulty.

The forms of the reduced variable models with one variable selected to represent each variable classification group are specified as follows:

DOLLAR = f (SIZE, SBRY, POP, TAXP, XVAL)

ADOLLAR = f (SIZE, SBRY, POP, TAXP, XVAL)

SALE = f (SIZE, SBRY, POP, TAXP, XVAL)

The regression results of the reduced variable model with variables selected to represent each general model classification group are presented in Table 5.14, Table 5.15 and Table 5.16 for the dependent variables DOLLAR, ADOLLAR and SALE respectively. The reduced variable models with DOLLAR, ADOLLAR and SALE as the dependent variables account for 52 percent, 30 percent and 50 percent of the variance for each dependent variable respectively. These results compare favorably with the results obtained using the unconstrained full variable regression model and the factor analysis based reduced models. Analysis of results of the general model classification based reduced models with DOLLAR, ADOLLAR and SALE as the dependent variables follows.

(i) Analysis of Results with DOLLAR as Dependent Variable

The regression results for the general model classification based reduced variable model with DOLLAR as the dependent variable are presented in Table 5.14. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.52. Adjusted R^2 is also 0.52. The standard error of the estimate is \$334.74 with an average (mean) predicted price of \$576.92 per acre. The standard error of the estimate is approximately 58 percent of the mean. These results are almost identical to the results obtained using the full variable model and the factor analysis based reduced model.

TABLE 5.14
REDUCED MODEL WITH VARIABLES SELECTED REPRESENTING GENERAL MODEL CLASSIFICATIONS WITH DOLLAR AS DEPENDENT VARIABLE

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
XVAL	-0.049	-0.029	-0.682	0.2478
SBRY	-15.913	-0.205	-6.151	0.0000
SIZE	-0.343	-0.039	-1.157	0.1241
TAXP	-0.029	-0.001	-0.024	0.4905
POP	5.512	0.719	10.390	0.0000
CONSTANT	-2457.663		-10.704	0.0000
F-TEST	97.437			0.0000
R^2	0.522			
ADJ. R^2	0.517			
STD. ERROR	334.736			

With DOLLAR as the dependent variable two independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: population for metropolitan Edmonton (POP), and straightline aerial distance to Edmonton city boundary (SBRY). All other variables were not significant at least at the 0.10 level.

The coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to distance measures and positively related to economic measures.

The beta coefficients presented in Table 5.14 indicate that POP and SBRY are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. POP is the single most important variable. The correlation coefficient between POP and DOLLAR is 0.69. Holding all other variables constant, land price per acre DOLLAR is increased by $5.51 for each increase of 1000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is also highly significant and conforms to the theoretical direction. Land price per acre, DOLLAR, is decreased by $15.91 for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

Size of land parcel (SIZE) was not significant at least at the 0.10 level but it demonstrated a declining relationship with the average price per acre as theorized.

(ii) Analysis of Results with ADOLLAR as Dependent Variable

The regression results for the general model classification based reduced variable model with ADOLLAR as the dependent variable are presented in Table 5.15. The regression coefficient is highly significant at the 0.0000 level with a coefficient of determination of 0.30. Adjusted R^2 is also 0.30. The standard error of the estimate is \$449.70 with an average (mean) predicted price of \$799.10 per acre. The standard error of the estimate is 56 percent of the mean. These results are comparable to the results obtained using the full variable model and the factor analysis based reduced model.

With ADOLLAR as the dependent variable three independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: size of parcel (SIZE), Metropolitan Edmonton population (POP) and straightline distance to Edmonton city boundary (SBRY). All other variables were not significant at least at the 0.10 level.

The coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and positively related to

TABLE 5.15
REDUCED MODEL WITH VARIABLES SELECTED REPRESENTING GENERAL MODEL CLASSIFICATIONS WITH ADOLLAR AS DEPENDENT VARIABLE

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
XVAL	0.000	-0.001	-0.025	0.4901
SBRY	-0.254	-0.295	-7.309	0.0000
SIZE	-0.007	-0.075	-1.861	0.0317
TAXP	-0.013	-0.060	-0.816	0.2073
POP	0.044	0.512	6.125	0.0000
CONSTANT	-12.526		-4.060	0.0001
F-TEST	38.668			0.0000
R^2	0.302			
ADJ. R^2	0.295			
STD. ERROR	4.497			

economic measures.

The beta coefficients presented in Table 5.15 indicate that POP and SBRY are again the most important variables in explaining variation in the dependent variable ADOLLAR, adjusted price per acre. POP is the single most important variable. The correlation coefficient between POP and ADOLLAR is 0.45. Holding all other variables constant, adjusted land price per acre ADOLLAR, is increased by $4.40 for each increase of 1000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is also highly significant and conforms to the theoretical direction. Adjusted land price per acre, ADOLLAR, is decreased by $25.40 for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

The size of land parcel in acres, SIZE, was theorized to decrease the average adjusted price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. SIZE is significant at the 0.032 level. The adjusted price per acre of the average parcel decreases $0.70 per acre for each additional acre of land in the parcel.

(iii) Analysis of Results with SALE as Dependent Variable

The regression results for the general classification based reduced variable model with SALE as the dependent variable are presented in Table 5.16. The regression coefficient is highly significant with a coefficient of determination of 0.50. Adjusted R^2 is also 0.50. The standard error of the estimate is $48616.87 with an average (mean) predicted price of $74890.00. The standard error of the estimate is 65 percent of the mean. These results are comparable with the results in the full variable and factor reduced variable models.

With SALE as the dependent variable three independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: size of parcel (SIZE), Metropolitan Edmonton population (POP), and straightline distance to Edmonton city boundary (SBRY). All other variables were not significant at least at the 0.10 level.

The coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

The beta coefficients presented in Table 5.16 indicate that POP, SIZE and SBRY continue to be the most important variables in explaining variation in the dependent variable SALE, total sale price. POP is the single most important

TABLE 5.16
REDUCED MODEL WITH VARIABLES SELECTED REPRESENTING GENERAL MODEL CLASSIFICATIONS WITH SALE AS DEPENDENT VARIABLE

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
XVAL	-0.609	-0.002	-0.058	0.4769
SBRY	-2297.991	-0.208	-6.116	0.0000
SIZE	455.194	0.361	10.554	0.0000
TAXP	1.949	-0.001	0.011	0.4956
POP	728.576	0.669	9.456	0.0000
CONSTANT	-395529.450		-11.860	0.0000
F-TEST	89.513			0.0000
R^2	0.501			
ADJ. R^2	0.495			
STD. ERROR	48616.87			

variable. The correlation coefficient between POP and SALE is 0.59. Holding all other variables constant total sale price, SALE, is increased by $728.58 for each increase of 1000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Parcel SIZE exhibited a direct relationship to total sale price, SALE, and was highly significant. On the average total sale price increases by $455.19 for each additional acre of land in the parcel.

Straightline distance to Edmonton city boundary (SBRY) is highly significant and conforms to the theoretical direction. Total sale price is decreased by $2297.99 for each additional mile in straightline distance that the parcel is located from the Edmonton city boundary.

I. Summary

The results of regression analysis, with DOLLAR, ADOLLAR and SALE as the dependent variables estimated in full variable and reduced variable forms are comparable. The reduction in number of variables tested from 36 in full variable model forms to 5 variables in reduced model forms did not produce any measurable difference in results.

The coefficients of determination and standard errors of the estimate provided equivalent results between the models tested. The coefficients generally conformed to the expected direction where land price is theorized to be negatively related to size distance measures and development restrictions or positively related to economic measures and potential for development. The magnitudes of the coefficients were reasonable.

The most important and significant variables generally common to all model forms were POP, SBRY, SIZE and LEDUC. Consistantly the single most important and significant variable in explaining the variation in the dependent variable was POP.

The full variable model provided insight into overall regression results based on the general land price prediction model. Factor analysis models were effective in removing multicollinearity and reducing variable redundancy. The reduced variable models provided confirmation that the general variable model may be adapted to prediction of land prices with a reduced number of variables. The next step involves application of the land price predictor model to analyzing submarkets where the factors influencing land prices are significantly different from each other.

J. Submarket Analysis

The analysis of the factor reduced variable model, with DOLLAR as the dependent variable, provides the basis to consider and test additional assumptions about the urban-rural land market in the study area. To test the assumption that the land market in the urban-rural fringe study area can be conceptualized as submarkets, where the factors influencing land prices are expected to be significantly different from each other, the factor reduced variable model is estimated for land transactions data segmented by county location and land use.

Factor analysis is the first procedure used to identify and simplify the dependence structure of the independent variables for the data segmented by county location and land use. Only one variable per factor group for the segmented data is selected to represent each factor group for use in regression analysis.

For land transactions data segmented by county location, using the full variable list, factor analysis identified the following: seven factors accounting for 83.5 percent of the variation for the County of Parkland, eight factors accounting for 83.1 percent of the variation for the County of Leduc, eight factors accounting for 81.7 percent of the variation in the County of Strathcona and eight factors accounting for 78.4 percent of the variation in the County of Sturgeon. The variables selected to represent each factor group for regression analysis common to all counties include POP, SBRY, SIZE, URES and RDA. The variable TSAT is common to all counties except Leduc. Both TRANS and NCR are common to all counties except Parkland. Unique variables selected include SBDV for Parkland and ROAD for Leduc. The variables selected to represent each factor group for county segmented data are similar to the variables selected to represent each factor group for the full variable model with aggregate data.

For land transactions data segmented by land use, using the full variable list, factor analysis identified nine factors accounting for 77.1 percent of the variation for agricultural land use and eight factors accounting for 80.3 percent of the variation for residential land use. The variables selected to represent each factor group for regression analysis common to both land use classifications include POP, SBRY, TSAT, ZRES, TRANS and ROAD. Unique variables selected for agricultural land use include NCR, PARK and RDA. Unique variables selected for residential land use include LEDUC and SIZE. The variables selected to represent each factor group for land use segmented data are also similar to the variables selected to represent each factor group for the full variable model with aggregate data.

County Location Analysis

The results of the factor reduced variable model for land transactions data segmented by county location are presented in Table 5.17, Table 5.18, Table 5.19 and Table 5.20. The county segmented submarket models, with DOLLAR as the dependent variable, account for 57 percent, 57 percent, 50 percent and 61 percent of the variance for the counties of Parkland, Leduc, Strathcona and Sturgeon respectively.

(i) Analysis of Results for The County of Parkland Submarket

Approximately 9 percent, or 40 observations out of a total of 452 observations, were selected as part of the Parkland submarket. The regression results for the factor reduced segmented model for the County of Parkland with DOLLAR as the dependent variable are presented in Table 5.17. The regression function is highly significant at the 0.0001 level with a coefficient of determination of 0.57. Adjusted R-square is 0.48 and the standard error of the estimate is $301.76.

With DOLLAR as the dependent variable only two independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP) and travel distance to the nearest satellite town (TSAT). All other variables were not significant at least at the 0.10 level.

The beta coefficients presented in Table 5.17 indicate that POP and TSAT are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. POP is the single most important variable. The correlation coefficient between POP and DOLLAR is 0.69. Holding all other variables constant, land price per acre increased by $4.14 for each increase of 1,000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic

TABLE 5.17
REGRESSION RESULTS FOR
COUNTY OF PARKLAND SUBMARKET

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
POP	4.144	0.715	5.865	0.0000
SBRY	-0.586	-0.006	-0.036	0.4858
SIZE	-0.631	-0.087	-0.645	0.2617
URES	86.026	0.093	0.731	0.2350
RDA	257.071	0.097	0.782	0.2201
TSAT	25.219	0.205	1.691	0.0502
SBDV	-19.113	-0.058	-0.371	0.3566
CONSTANT	-1986.672		-4.102	0.0002
F-TEST	6.151			0.0001
R^2	0.574			
ADJ. R^2	0.480			
STD. ERROR	301.761			
OBSERVATIONS (n)	40			

development on land prices due to population growth factors.

The coefficient for TSAT is unexpectedly positive while the other coefficients are not significant at the 0.10 level they generally conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

Straightline distance to Edmonton city boundary (SBRY) conforms to the theoretical direction. Land price per acre, DOLLAR, is decreased by $0.59 for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

The SIZE of land parcel in acres of the transaction was theorized to decrease the average price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. The -0.63 regression coefficient indicates that the price per acre of an average parcel decreases $0.63 per acre for each additional acre of land in the parcel.

Potential for future residential land use is captured in the combined effect of the variables URES and RDA. The average price per acre is increased by $86.03 for land use residential (URES) and $257.07 for location in a restricted development area (RDA). In the study area, land in a restricted development area is located generally in close proximity to city boundaries and airports making it suitable for large size country residential estate development.

(ii) Analysis of Results For The County of Leduc Submarket

Approximately 32 percent, or 143 observations out of a total of 452 observations were selected as part of the County of Leduc submarket. The regression results for the factor reduced segmented model for the County of Leduc with DOLLAR as the dependent variable are presented in Table 5.18. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.57. Adjusted R-square is 0.54 and the standard error of the estimate is $336.21.

With DOLLAR as the dependent variable three independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP), straightline distance to the Edmonton city boundary (SBRY) and the number of country residential land parcels created (NCR). All other variables were not significant at least at the 0.10 level.

The beta coefficients presented in Table 5.18 indicate that POP and SBRY are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. POP is again the single most important variable. The correlation coefficient between POP and

TABLE 5.18
REGRESSION RESULTS FOR
COUNTY OF LEDUC SUBMARKET

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
POP	6.234	0.749	12.746	0.0000
SBRY	-14.703	-0.146	-2.476	0.0072
SIZE	-0.255	-0.025	-0.433	0.3327
URES	35.476	0.015	0.266	0.3954
RDA	45.478	0.030	0.528	0.2992
NCR	-0.595	0.075	-1.306	0.0968
TRANS	-0.002	-0.053	-0.893	0.1868
ROAD	-16.528	-0.052	-0.882	0.1897
CONSTANT	-2714.963		-7.354	0.0000
F-TEST	22.173			0.0000
R^2	0.570			
ADJ. R^2	0.544			
STD. ERROR	336.211			
OBSERVATIONS (n)	143			

DOLLAR is 0.69. Holding all other variables constant, land price per acre increased by $6.23 for each increase of 1,000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is significant and conforms to the theoretical direction. Land price per acre, DOLLAR, is decreased by $14.70 per acre for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

The number of country residential land parcels created (NCR) is a supply variable and decreases the average price per acre for increases in supply as theorized. The average price per acre is decreased by $0.60 for each country residential land parcel added to the supply in the year of sale.

While the other variable coefficients are not statistically significant at the 0.10 level the coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

The SIZE of land parcel in acres of the transaction was theorized to decrease the average price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. The -0.26 regression coefficient indicates that the price per acre of an average parcel decreases $0.26 per acre for each additional acre of land in the parcel.

Potential for future residential development is again captured in the combined effect of the variables URES and RDA. The average price per acre is increased by $35.48 for land use residential (URES) and $45.48 for location in a restricted development area (RDA). Land in a restricted development area is located in close proximity to airports and city boundaries making it suitable for large size country residential estate development.

The negative coefficient for ROAD reflects a priori reasoning that land price will decline as frontage road condition decreases. The average price per acre decreases by $16.53 for each additional class decrease in the measure of frontage road quality classification.

(iii) Analysis of Results For The County Of Strathcona Submarket

Approximately 18 percent or 80 observations out of a total of 452 observations were selected as part of the County of Strathcona submarket. The regression results for the factor reduced segmented model for the County of Strathcona with dollar as the dependent variable are presented in Table 5.19. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.50. Adjusted R-square is 0.45 and the standard error of the estimate is $379.05.

With DOLLAR as the dependent variable four independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP), land use residential (URES), number of country residential land parcels created (NCR) and the total number of acres of land transferred in the year of sale (TRANS). All other variables were not significant at least at the 0.10 level.

The beta coefficients presented in Table 5.19 indicate that POP, NCR, URES and TRANS are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. POP is again the single most important variable. The correlation coefficient between POP and DOLLAR is 0.69. Holding all other variables constant, land price per acre increased by $5.19 for each increase of 1,000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

The number of country residential land parcels created (NCR) is a supply variable and is theorized to decrease the average price per acre. An unexpected positive coefficient for NCR appears increasing the average price per acre by $0.70 for each country residential land parcel added to the

TABLE 5.19
REGRESSION RESULTS FOR
COUNTY OF STRATHCONA SUBMARKET

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
POP	5.194	0.640	7.124	0.0000
SBRY	0.139	0.002	0.015	0.4941
SIZE	-0.118	-0.015	-0.171	0.4325
URES	193.547	0.181	2.042	0.0224
RDA	89.345	0.020	0.227	0.4103
NCR	0.697	0.240	2.635	0.0051
TRANS	-0.007	-0.142	-1.572	0.0602
TSAT	1.224	0.014	0.135	0.4466
CONSTANT	-2687.013		-5.826	0.0000
F-TEST	8.975			0.0000
R^2	0.503			
ADJ. R^2	0.447			
STD. ERROR	379.054			
OBSERVATIONS (n)	80			

supply in the year of sale.

Potential for future residential development demonstrates the positive a priori effect on land price per acre for observations located in a land use residential (URES) area. The average price per acre is increased by $193.55 for land parcels designated as land use residential.

The negative coefficient for TRANS, total number of acres of land transferred in the year of sale, continues to confirm this variable as an indicator of satisfied market demand. However the effect of TRANS on land price per acre is not strong. The average price per acre is only decreased by $0.005 for each additional acre of land transferred.

While the other variable coefficients are not statistically significant at the 0.10 level they exhibit mixed signs. The coefficients for the accessibility distance measures SBRY and TSAT are unexpectedly positive. Location in a restricted development area (RDA) adds $89.35 to the average price per acre.

The SIZE of land parcel in acres of the transaction was theorized to decrease the average price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. The -0.12 regression coefficient indicates that the price per acre of an average parcel decreases $0.12 per acre for each additional acre of land in the parcel.

(iv) Analysis of Results for The County of Sturgeon Submarket

Approximately 42 percent, or 188 observations out of a total of 452 observations, were selected as part of the County of Sturgeon submarket. The regression results for the factor reduced segmented model for the County of Sturgeon with DOLLAR as the dependent variable are presented in Table 5.20. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.61. Adjusted R-square is 0.59 and the standard error of the estimate is $301.99.

With DOLLAR as the dependent variable four independent variables were calculated to be statistically signifcant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP), straightline distance to the Edmonton city boundary (SBRY), parcel size in acres (SIZE) and the total number of acres of land transferred in the year of sale (TRANS). All other variables were not significant at least at the 0.10 level.

The beta coefficients presented in Table 5.20 indicate that POP, SBRY, SIZE and TRANS are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. POP is again the single most important variable. The correlation coefficient between POP and ADOLLAR is 0.69. Holding all other variables constant, land price per acre increased by $5.37 for each increase of 1,000 in population for metropolitan Edmonton. The

TABLE 5.20
REGRESSION RESULTS FOR
COUNTY OF STURGEON SUBMARKET

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
POP	5.366	0.709	14.218	0.0000
SBRY	-18.736	-0.261	-4.846	0.0000
SIZE	-0.707	-0.079	-1.592	0.0565
URES	96.870	0.056	1.176	0.1205
RDA	28.830	0.016	0.322	0.3741
NCR	-0.0003	0.0001	0.002	0.4990
TRANS	-0.004	-0.131	-2.739	0.0034
TSAT	-4.625	-0.045	-0.830	0.2038
CONSTANT	-2152.532		-8.632	0.0000
F-TEST	34.780			0.0000
R^2	0.609			
ADJ. R^2	0.591			
STD. ERROR	301.992			
OBSERVATIONS (n)	188			

coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is highly significant and conforms to the theoretical direction. Land price per acre, DOLLAR, is decreased by $18.74 for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

The SIZE of land parcel in acres of the transaction was theorized to decrease the average price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. SIZE is significant at the 0.057 level. The -0.71 regression coefficient indicates that the price per acre of an average parcel decreases $0.71 per acre for each additional acre of land in the parcel.

The negative coefficient for TRANS, total number of acres of land transferred in the year of sale, confirms this variable as an indicator of satisfied demand. The effect is not strong as the average price per acre is only decreased by $0.004 for each additional acre of land transferred.

While the other variable coefficients are not statistically significant at the 0.10 level the coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

Potential for future residential development is again captured in the combined effect of the variables URES and RDA. The average price per acre is increased by $96.87 for land use residential (URES) and $28.83 for location in a restricted development area. Land located in a restricted development area is located in close proximity to airports and city boundaries making it suitable for large size country residential estate development.

Travel distance to the nearest satellite town (TSAT) conforms to the theoretical direction and land price per acre is decreased by $4.63 for each additional mile in travel distance.

(v) Summary

The results of regression analysis of the factor reduced variable model, estimated for land transactions data segmented by county location, confirmed a priori expectations that the land market in the urban-rural fringe study area can be conceptualized as submarkets, where the factors influencing land prices are significantly different from each other. Only one independent variable, POP which represents the combined influence of economic growth factors on land price, is common to all counties and significant at the 10 percent level. All of the other variables selected are unique to each county. This confirms a priori expectations that location factors exert a strong influence on land value and geographic location considerations are unique and distinctive to each county.

Land Use Analysis

The results of the factor segmented variable model for land transactions data segmented by land use are presented in Table 5.21. and Table 5.22. The land use segmented submarket models, with DOLLAR as the dependent variable, account for 52 percent and 54 percent of the variance for land uses of residential and agricultural respectively.

(i) Analysis of Results For The Agricultural Land Use Submarket

The regression results for the factor reduced segmented model for agricultural land use with DOLLAR as the dependent variable are presented in Table 5.21. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.54. Adjusted R-square is 0.53 and the standard error of the estimate is $333.09.

With DOLLAR as the dependent variable only two independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP) and straightline distance to the Edmonton city boundary (SBRY).

TABLE 5.21
REGRESSION RESULTS FOR
AGRICULTURAL LAND USE SUBMARKET

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
POP	5.479	0.711	19.895	0.0000
SBRY	-14.921	-0.186	-4.841	0.0000
TSAT	-0.740	-0.008	-0.209	0.4172
ZRES	19.442	0.017	0.474	0.3179
TRANS	-0.001	-0.041	-1.092	0.1377
ROAD	-5.523	-0.189	-0.525	0.2999
NCR	-0.083	-0.032	-0.829	0.2038
RDA	63.986	0.035	0.999	0.1592
PARK	-12.152	-0.007	-0.181	0.4281
CONSTANT	-2458.564		-13.025	0.0000
F-TEST	49.018			0.0000
R^2	0.538			
ADJ. R^2	0.527			
STD. ERROR	333.088			
OBSERVATIONS (n)	389			

The beta coefficients presented in Table 5.21 indicate that POP, SBRY, and ROAD are the most important variables in explaining variation in the dependent variable DOLLAR, land price per acre. POP is again the single most important variable. The correlation coefficient between POP and DOLLAR is 0.69. Holding all other variables constant, land price per acre increased by $5.48 for each increase of 1,000 in population for metropolitan Edmonton. the coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is highly significant and conforms to the theoretical direction. Land price per acre, DOLLAR, is decreased by $14.92 per acre for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

While the other variable coefficients are not statistically significant at the 0.10 level, the coefficients conform to the expected theoretical direction. Land price is theorized to be negatively related to size, distance measures and development restrictions or positively related to economic measures and potential for development.

Travel distance to the nearest satellite town (TSAT) conforms to the theoretical direction and land price per acre is decreased by $0.74 for each additional mile in travel distance.

Potential for future residential development is captured in the combined effect of the variables ZRES and RDA. The average price per acre is increased by $19.44 for land zoned residential (ZRES) and $63.99 for location in a restricted development area (RDA). Land in a restricted development area is located in close proximity to airports and city boundaries making it suitable for large size country residential estate development.

The negative coefficient for TRANS, total number of acres of land transferred in the year of sale conforms to theoretical direction as an indicator of satisfied market demand but its effect is not strong. Average price per acre is only decreased by $0.001 for each additional acre of land transferred.

The negative coefficient for ROAD reflects a priori reasoning that land price will decline as frontage road condition decreases. The average price per acre decreases by $5.52 for each additional class decrease in the measure of frontage road quality classification.

The number of county residential land parcels created (NCR) is a supply variable and decreases the average price per acre for increases in supply as theorized. The average price per acre is decreased by $0.08 for each country residential land parcel added to the supply in the year of sale.

Location in the County of Parkland decreases the intercept price by $12.15 per acre for agricultural land use. Land located in the County of Parkland is characterized as wooded, poor soil quality and spotted with pot hole lakes rendering it unsuitable for the majority of agricultural productive uses.

(ii) Analysis of Results For The Residential Land Use Submarket

The regression results for the factor reduced segmented model for residential land use with DOLLAR as the dependent variable are presented in Table 5.22. The regression function is highly significant at the 0.0000 level with a coefficient of determination of 0.52. Adjusted R-square is 0.44 and the standard error of the estimate is $348.81.

With DOLLAR as the dependent variable three independent variables were calculated to be statistically significant at the 0.10 level of probability using a one tail test: Metropolitan Edmonton population (POP), straightline distance to the Edmonton city boundary (SBRY) and frontage road condition (ROAD).

The beta coefficients presented in Table 5.22 indicate that POP, SBRY and ROAD are the most important variables in explaining variation in the dependent variable DOLLAR land price per acre. POP is again the single most important variable. The correlation coefficient between POP and

TABLE 5.22
REGRESSION RESULTS FOR
RESIDENTIAL LAND USE SUBMARKET

Variable	Regression Coefficient (b-value)	Standardized Coefficient (Beta)	t-Statistic	Probability > t (Significant t)
POP	5.025	0.656	6.381	0.0000
SBRY	-19.167	-0.261	-2.223	0.0153
TSAT	2.291	0.030	0.246	0.4032
ZRES	-52.309	-0.020	-0.194	0.4235
TRANS	-0.002	-0.122	-0.977	0.1667
ROAD	51.952	0.191	1.903	0.0313
SIZE	-0.302	-0.035	-0.326	0.3727
LEDUC	-7.954	-0.006	-0.044	0.4824
CONSTANT	-2224.418		-3.847	0.0001
F-TEST	6.858			0.0000
R^2	0.518			
ADJ. R^2	0.443			
STD. ERROR	348.809			
OBSERVATIONS (n)	60			

DOLLAR is 0.69. Holding all other variables constant, land price per acre increased by \$5.03 for each increase of 1,000 in population for metropolitan Edmonton. The coefficient for POP is positive as expected to reflect increased economic development on land prices due to population growth factors.

Straightline distance to Edmonton city boundary (SBRY) is highly significant and conforms to the theoretical direction. Land price per acre, DOLLAR, is decreased by \$19.17 per acre for each additional mile in straightline distance that the sample observation is located from the Edmonton city boundary.

The coefficient for ROAD is unexpectedly positive. A priori expectations are that land price will decline as frontage road condition decreases. However, the average price per acre increases by \$51.95 for each additional class decrease in the measure of frontage road quality classification.

The other variable coefficients have unexpected mixed signs and are not statistically significant at the 0.10 level. Unexpected signs include a positive coefficient for TSAT and a negative coefficient for Leduc.

The negative coefficient for TRANS conforms to the theoretical direction as an indicator of satisfied market demand but its effect continues to be weak. Average price per acre is only decreased by \$0.002 for each additional acre of land transferred.

The SIZE of land parcel in acres of the transaction was theorized to decrease the average price per acre. The size of the land parcel purchased varied inversely to the price per acre as theorized. The -0.30 regression coefficient indicates that the price per acre of an average parcel decreases $0.30 per acre for each additional acre of land in the parcel.

(iii) Summary

In comparison with the results obtained using the full variable factor reduced model the results are equally favorable when the data is segmented by agricultural use. All of the coefficients conform to the expected theoretical direction and have reasonable magnitudes. The results are not surprising when the number of observations for the agricultural use designation are considered. Approximately 86 percent, or 389 observations out of a total of 452 observations, were selected as part of the agricultural use submarket. For practical purposes the agricultural use segmented model and the full variable factor reduced model are the same.

The results with the data segmented for residential land use must be viewed with caution. The variables selected as significant in the prediction of land price include population related variables representing the derived demand for land and distance accessibility measures. The signs of the coefficients are mixed and do not conform to expected theoretical direction.

The commercial land use market segmentation comprised less than one percent of the total number of observations. Only 3 observations out of a total of 452 were selected as part of the commercial land use submarket. This number is too small to allow use of the regression technique in analyzing commercial land use prices. Therefore, no conclusions are made in respect to the commercial land use model.

Population (POP), and accessibility (SBRY) are the only common variables represented in both the residential and agricultural land use models. The overwhelming influence of population as a representation of economic growth factors and of the importance of accessibility is clear. All of the other variables which were selected are unique to each model.

K. Model Validation Results

Model validation involves the determination that the model will function as intended. It includes a study of the stability of regression coefficients and determination that coefficient signs and magnitudes are reasonable. Validation includes an investigation of the model's prediction performance by evaluating the differences between predicted and actual transaction prices.

A regression model is identified for purposes of validation. Whereas the model is selected for applied use in a variety of land price prediction situations the resulting model must be easy to understand and simple to use. Therefore, the model is selected for simplicity, ease of data collection, cost and accuracy of prediction. The model selected for use in validation testing will be the factor analysis based reduced model where only one variable per factor is selected to represent each factor group. This model is specified as follows:

DOLLAR = f (SBRY, POP, LEDUC, ASUB, TSAT,
SIZE, TRANS, SCONA, RDA)

The model is validated by evaluating the differences between predicted and actual transactions prices. The validation test is a test of the stability of the estimated relationship. The predictive capability of the model is tested by using the estimated model to predict transactions prices of the dependent variable and comparing the results to actual transactions prices.

The most effective method of validating a regression model with respect to its predictive performance is to collect fresh data and directly compare the model predictions against it. However, this method is rejected in the current study due to the time effort and cost of collecting, coding and verifying new data. When the collection of new data for validation purposes is not possible, a suggested procedure is to split the available data into two parts, the estimation data and the prediction data. The estimation data is used to build the model and the prediction data is used to study the predictive ability of the model.

The PRESS statistic is considered as a form of data splitting. To calculate PRESS an observation is deleted and the regression model is fitted to the remaining n-1 observations. The prediction error, the deleted residual, for the deleted observation is calculated. The PRESS statistic is defined as the sum of the squares of the n deleted residuals.

The PRESS statistic is calculated for the factor analysis based reduced model using the SAS computer program.[63] The value of PRESS = 53403722 is close to the value of the residual sum of squares, SSE = 51142503 for this model. To estimate the performance of the model as a predictor PRESS is used to calculate an approximate R-square for prediction as follows:[64]

$$R^2\text{prediction} = 1 - \frac{\text{PRESS}}{\text{Syy}}$$

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[63] "SAS User's Guide: Statistics", Version 5, SAS Institute Inc., Cary, North Carolina, 1985.

[64] Douglas C. Montgomery and Elizabeth A. Peck, Introduction to Regression Analysis, Wiley, (New York: 1982), P.432.

Applying the above formula the estimated R-square for prediction is 0.489. It is therefore expected that the PRESS model will account for 49 percent of the variability in predicting new observations, as compared to the approximately 51 percent of the variability in the original data explained by the least squares fit.

In addition residual analysis was performed on all of the models tested to check for adequacy. Model assumptions, such as linearity of the regression function, normality of the error term, and constant variance were examined for appropriateness of the model. Residual analysis formed the basis for this examination. Also all of the coefficients of the final regression model were examined for stability, reasonableness and conformity to the expected theoretical direction.

The models formulated and tested in this study may be validated further through the collection of additional new observations or by replication in other geographic areas. The relationships tested in this study may be tested to be more stable in other geographic locations and as a result, produce more satisfactory conclusions related to a land price predictor model. However, real estate markets contain individual and unique characteristics. Therefore, the applicability of the results of this research to other geographic areas must be made with caution. Statistical and economic variances between geographic locations make the transferability of results from one geographic location to another inappropriate.

L. Summary

Chapter V presents the analysis and results of predictive models of land transaction prices under the influence of a major urban concentration. The models specify variables which represent forces hypothesized to have an influence on land transaction prices in the Metropolitan Edmonton Regional Planning Area. The models are specified in linear and transformed variable functional forms. The models vary to reflect actual market activity and to include variables which were constructed from limited data.

Chapter VI is a review of the major components of this research study with a presentation of the summary and conclusions of the research. It examines statistical and economic interpretations in light of the hypothesis of the study as well as develops economic conclusions and implications. The chapter concludes with recommendations for future research.

VI. SUMMARY AND CONCLUSIONS

Chapter V presented the empirical results and analysis of results from a statistical and an theoretical perspective. In many cases the statistical relationships imply relationships of influences on land transaction prices. These relationships provide a basis for conclusions and implications to be developed in this chapter.

Chapter VI reviews the results of the research and assesses the extent to which the objectives of this study have been accomplished. It outlines conclusions as to the relationships influencing land transaction prices in the Edmonton region. Implications of specific relationships influencing land are discussed including the long run consequences of the relationships on land transaction prices. The chapter concludes with an evaluation of the research techniques used in this study and offers a number of recommendations for future research on land price predictor models.

A. Summary

This study constructed and tested a model to predict the transaction price of land located in the urban-rural fringe. The objective was to estimate and analyze a land market price function to improve the investor/developer's rationalization of the market for land.

The objective was accomplished through the development of a land price predictor model, and the estimation and analysis of this model for the Edmonton Regional Planning Area. First, the model is developed with hypotheses about the expected impacts on land price of the level of urban and regional economic development, accessibility to economic activities, site and location characteristics, institutional factors and land market activity. Second, a description of the study area, sampling procedure and the data are provided. Third, statistical estimates and their analysis are presented.

Regression analysis was used to estimate the hypothesized relationships in a series of linear and transformed variable single-equation models. Factor analysis was applied to reduce redundancy among variables and to identify a smaller number of underlying factors. The predictive model of land transaction prices was applied to analysis of the data stratified by county location and land use to test the predictive capability of the model along these micro market dimensions. The model was validated by using the estimated model to predict transaction prices and comparing the results to actual transaction prices.

B. Conclusions

No one particular model was superior in illustrating the functioning of the land market in the urban-rural finge because of statistical complications associated with data collected over time and the limited number of independent variables which could be included in a model. Many of the models tended to be of a reduced form measuring the total influences of long term economic trends and aggregating variations in short term economic cycles.

Despite the limitations imposed by statistical influences, the statistical results confirmed the influence of expected theoretical relationships on land transaction prices. The relationships were derived from many different model specifications and were observed in models that do not necessarily reflect the interrelated nature of the many forces which have been hypothesized to have an influence on land price.

The results of regression analysis, with DOLLAR, ADOLLAR and SALE as the dependent variables estimated in full variable and reduced variable forms are comparable. The reduction in number of variables tested from 36 in full variable model forms to 5 variables in reduced model forms did not produce any measurable difference in results.

The coefficients of determination and standard errors of the estimate provided equivalent results between the models tested. The coefficients generally conformed to the expected direction where land price is theorized to be negatively related to size distance measures and development restrictions or positively related to economic measures and potential for development. The magnitudes of the coefficients were reasonable.

The most important and significant variables generally common to all model forms were POP, SBRY, SIZE and LEDUC.

Consistently the single most important and significant variable in explaining the variation in the dependent variable was POP.

The full variable model provided insight into overall regression results based on the general land price prediction model. Factor analysis models were effective in removing multicollinearity and reducing variable redundancy. The reduced variable models provided confirmation that the general variable model may be adapted to prediction of land prices with a reduced number of variables.

A model incorporating most of the economic relationships which function to determine land prices is not likely to be achieved since multicollinearity restricts the number of variables which can statistically be included in a model. As a result, the models presented have the characteristics of reduced form models which describe relationships among variables representing economic forces. The economic content of these models may be limited since all of the direct economic influences on land prices suggested by economic theory are not included.

This research focused on the study of variations in urban-rural land prices with the objective of obtaining knowledge concerning prediction of land transaction prices. Relationships between specific factors and land price were hypothesized to be the functional components of the land markets which determine land prices in the Edmonton

Regional Planning Area. The empirical testing procedure implied theoretical relationships which might function with respect to land prices under the influence of a major urban concentration.

Many of the independent variables observed over time demonstrated similar variations as a result of the influence of economic cycles. As well, some of the variables, rather than being independent, may have cause and effect relationships where two variables may be measuring a similar economic influence. Unfortunately, these relationships present statistical limitations to conclusions and economic inferences.

A number of economic factors are indicated as having an influence on land prices under the influence of a major urban concentration. However, this empirical analysis does not result in definitive conclusions with respect to these economic factors. Land transaction prices in the Edmonton region are determined in many individual micro-markets which are not entirely linked to one another. Therefore, the relative influence of variables may be determined by a unique set of factors in these individual markets.

The results of regression analysis of the factor reduced variable model, estimated for land transactions data segmented by county location, confirmed a priori expectations that the land market in the urban-rural fringe study area could be conceptualized as submarkets, where the factors influencing land prices are significantly different from each other.

The variables selected to represent each factor group for regression analysis common to all counties include POP, SBRY, SIZE, URES and RDA. The variable TSAT is common to all counties except Leduc. Both TRANS and NCR are common to all counties except Parkland. Unique variables selected include SBDV for Parkland and ROAD for Leduc.

Only one independent variable, POP which represents the combined influence of economic growth factors on land price, is common to all counties and significant at the 10 percent level. All of the other variables selected are unique to each county. This confirms a priori expectations that location factors exert a strong influence on land value and geographic location considerations are unique and distinctive to each county.

In comparison with the results obtained using the full variable factor reduced model the results are equally favorable when the data is segmented by agricultural use. All of the coefficients conform to the expected theoretical direction and have reasonable magnitudes. The results are not surprising when the number of observations for the agricultural use designation are considered. Approximately 86 percent, or 389 observations out of a total of 452 observations, were selected as part of the agricultural use submarket. For practical purposes the agricultural use segmented model and the full variable factor reduced model are the same.

The results with the data segmented for residential land use must be viewed with caution. The variables selected as significant in the prediction of land price include population-related variables representing the derived demand for land and distance accessibility measures. The signs of the coefficients are mixed and do not conform to expected theoretical direction.

The commercial land use market segmentation comprised less than one percent of the total number of observations. Only 3 observations out of a total of 452 were selected as part of the commercial land use submarket. This number is too small to allow use of the regression technique in analyzing commercial land use prices. Therefore, no conclusions are made in respect to the commercial land use model.

Population (POP), and accessibility (SBRY) are the only common variables represented in both the residential and agricultural land use models. The overwhelming influence of population as a representation of economic growth factors and of the importance of accessibility is clear. All of the other variables which were selected are unique to each model.

The relationships hypothesized to influence land prices have been formulated based on theoretical and empirical research. However, real estate markets contain individual and unique characteristics. Therefore, the applicability of the results of this research to other geographic areas must be made with caution. However, the relationships tested in this study may be tested to be more stable in other geographic locations and as a result, produce more satisfactory conclusions related to the hypothesized land price predictor model. Statistical and economic variances between geographic locations make the transferability of results from one geographic location to another inappropriate.

While all of the independent variables examined can be expected to influence land transaction price to some extent, the degree to which they do so and their influence relative to one another appear to vary over time. The number, size and characteristics of land parcels for any urban center change over time with changing price and cost expectations, such as changes in economic conditions and the development of roads, residential areas, and industrial and retail centers.

Prediction of land prices is also hindered by several characteristics of land itself and land market activities. Owners can erect dwelling units and other buildings, clear forests and trees or plant crops on open land. All of these actions, which are exogenous to a predictive model, cannot be accurately forseen and will affect the potential sales price of any given land parcel.

In conclusion, the results of regression analysis on land transaction prices under the influence of a major urban concentration failed to explain enough of the variance in land prices to be used as an accurate predictive device. The variation around the price predicted for any given parcel was too great to be used in micro-scale planning at the level of individual land parcels. However, in comparison with previous research of a similar nature the results may be considered to be acceptable.

C. Recommendations for Future Research

This study attempted to estimate a model to predict land transaction prices under the influence of a major urban concentration. The objectives of this study included determination of variables which exert an influence on land prices and development of models to test the variables hypothesized to have an influence on land transaction prices. Economic theory relating to land prices and information from previous empirical studies were used to develop the hypothesized predictive models.

Not all of the objectives set out in this study were achieved. The models presented tended to be of a reduced form and thus did not reveal the many forces which determine land prices. The estimated coefficients of independent variables were influenced by the inclusion or exclusion of other variables which might be similarly related. The aggregated nature of these data likely also contributed to the high level of correlation among the variables. Therefore, improved analyses may be gained in future studies by using data which are less highly aggregated and by using transformations of the data which might reduce the levels of correlation and improve the fit of the model.

The influence of a major urban concentration, measured by the level of urban and regional economic development, on land price was tested as a hypothesis but may have been victimized by an inefficient model. This economic force deserves greater emphasis in future studies. Improvement in the predictive capability of land price predictor models may be achieved through alternative methods of variable specification, measurement and transformation.

Agricultural land use and productive returns are expected to have a direct influence on land prices in the urban-rural fringe. These expectations are described as subjective formulations of the present and future economic benefits which might accrue to agricultural land. Future research into urban-rural land prices should incorporate agricultural productivity measures in an attempt to estimate the influence of productive returns on land price.

Lack of accurate land market data is a problem for real estate research. Obtaining the original land market data from primary and secondary sources was a large and time consuming task. Data collection, coding, input and correction occupied an extreme amount of time and energy. A contribution of this research effort is to share this land market data with a wider audience for future research. The complete data listing is presented in Appendix B.

To overcome data limitations due to collection problems an effective market reporting of land transactions would be helpful. If numbers of parcels, total land area, location of parcels, prices paid and other terms of sale were widely reported and generally publicized, this would provide a solid factual basis now lacking. The reports might be limited to information of public record such as land title transfers or assurance fund values. However, consistent and accurate data is critical to effective future research into land price predictor models.

APPENDIX A

ROTATED FACTOR MATRIX

ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9
SCBD	.92017	.08198	-.13649	-.09097	.04963	-.05519	.05450	-.06284	.02706
SBRY	.91493	.01701	-.06847	-.11847	.03871	-.06993	-.08835	-.05843	.04120
TSC	.91143	.04898	-.19304	-.06334	.20398	-.04714	.02898	-.00733	-.00086
TBRY	.90800	.04020	-.12729	-.08569	.22564	-.06359	.00320	-.02314	.01385
TCBD	.90069	.08086	-.16074	-.03961	.21610	-.06049	.12193	.00434	-.00374
METRO	-.66097	-.14278	-.12933	-.02078	-.00991	.10080	-.10520	.13244	.36321
THWY	.56813	-.04055	-.05710	.27026	.10544	.00836	.06318	.01968	.05163
SBDV	.55320	.02208	-.14165	-.34933	.43094	-.05490	.00444	.00910	.09995
URBAN	-.50577	-.12328	-.13341	.00126	.02717	.12717	-.19898	.08695	.50541
DPOP	-.43501	-.04103	.01650	.37475	.04884	-.13606	-.31178	-.14883	.06302
OPEC	.04206	.98461	-.02062	-.02588	.05174	-.01794	-.05176	-.01217	.00041
POP	.06290	.98057	.00822	-.03376	.04554	-.01409	-.00014	-.04552	.01531
TIME	.06572	.96367	.03771	-.04100	.03925	-.02076	.08466	-.07857	.00905
INTRT	.10690	.87431	.03501	-.01718	.01213	-.00506	.05770	-.07642	.02164
TAXP	.10771	.84593	-.35284	-.05887	.00024	-.03422	.05002	.16515	-.01186
GPOP	-.02207	.69127	-.17708	.00366	.01991	-.00391	-.44810	.22804	-.08675
XVAL	-.00025	.55530	.49197	.03517	.04097	.02512	.14589	-.47177	-.02480
ACR	-.21895	-.03143	.84688	.05622	.09695	-.03477	-.01168	.05731	-.01425
NCR	-.12040	-.13879	.79567	.02153	-.01417	-.05491	-.12564	.10059	-.06794
LEDUC	.11297	.02405	-.67122	-.06411	.25908	.01951	.49172	-.03515	.05356
ZRES	-.00225	.00118	-.00206	.80050	.15766	-.06303	.00997	.01772	.03304
URES	-.13299	-.03754	.04920	.76547	.05607	-.04012	-.05845	-.05193	-.18409
SOIL	.24035	-.00143	.06407	.64462	.01766	.03757	-.02478	.14303	.24596
ASUB	-.41916	-.09259	.05854	.61538	-.13529	.06377	-.06906	.04314	.03341
TSAT	.39479	.11199	.00558	.15820	.82633	-.02613	-.00831	-.08318	.00497
SAT	.38716	.10453	-.00509	.15594	.81312	-.03478	.00820	-.05085	.01904
ZCOM	-.09963	-.01499	-.03136	-.02999	-.04750	.86297	.01742	-.07058	.08252
UCOM	-.08571	-.07796	-.06203	-.04813	-.05035	.85580	-.07996	-.00265	.01761
SIZE	.07968	-.21373	-.04617	-.06783	-.09155	-.23216	-.08654	-.18579	-.09434
TRANS	.12698	.01897	-.31521	-.08929	.04206	-.05607	.84762	.10574	.05295
PARK	-.22212	-.01407	.25398	.13880	-.01025	-.03640	.04231	.79722	-.02799
SCONA	-.30331	-.06543	.38151	.25518	.30401	.07733	-.35732	-.51717	-.04092
RDA	.07420	.04084	-.03018	.01985	.02771	.05306	.17296	.00559	.73903
ROAD	.07978	-.04207	.03733	-.07150	.38341	-.05328	.19618	.14569	-.38569

APPENDIX B

DATA LISTING

DATA LISTING

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ID    SALE SIZE DOLLAR TIME POP    CPI  SCBD  SBRY   SAT  THWY  TCBD  TBRY  TSAT   TSC  SBDV  INTRT

 1   35000   52    673    1 520   41.9  10.5   3.0   6.0   1.0  11.0   3.5   6.0   5.5   3.0   7.00
 2   14699  310     47    2 520   41.9  32.0  26.0   2.0  24.5  35.0  29.0   2.0  31.5   2.0   7.00
 3   25000   38    658    2 520   41.9  17.0  11.5   7.0   5.0  19.0  12.0   9.0  16.0    .0   7.00
 4   18000  160    113    3 520   41.9  37.0  30.0   5.0  28.0  41.0  37.0   7.0  40.0   7.0   6.50
 5   24000   80    300    3 520   41.9  16.0  10.0   5.5   7.0  24.0  19.0   7.0  19.0   1.0   6.50
 6    3470  160     22    3 520   41.9  20.0  13.0   3.0  10.0  29.0  12.5   4.5  15.5   3.0   6.50
 7   18000  160    113    3 520   41.9  28.5  24.5  10.0   6.5  35.5  32.5   6.5  34.0   6.5   6.50
 8  536500  214   2507    3 520   41.9   6.0   1.0   5.0   5.0   8.0   1.0   5.0   3.0   1.0   6.50
 9   29000   80    363    3 520   41.9  18.0  12.5   8.0   6.0  20.0  13.0  10.0  17.0    .0   7.00
10   29000   80    363    3 520   41.9  28.0  26.0   3.0  20.5  38.0  30.0   3.0  28.0   2.5   6 50
11  120000  116   1034    3 520   41.9   7.0   2.0   5.5   3.0   9.0   1.5   6.0   5.5   3.0   6.50
12    8500  153     56    3 520   41.9  20.5  15.5   4.0   2.0  21.5  17.0   5.0  21 5   2.0   6.50
13   10000  152     66    3 520   41.9  29.5  23.0  12.0  10.5  40.5  34.5  25.0  43.5   9.5   6.50
14   20000  253     79    3 520   41.9  28.0  23.0  10.0   8.0  34.0  29.0  14.0  30.0  14.0   6.50
15   30000  153    196    4 520   41.9  19.0  13.5   2.0  14.0  21.0  14.5   2.0  17.5   1.0   6.50
16   10500  192     55    4 520   41.9  24.0  18.0   9.0    .0  24.0  18.0   9.0  20.5   2.5   6.50
17   60000  160    375    5 520   41.9  17.0  10.0   2.0   6.0  21.0  15.5   3.0  18.5   3.0   6.50
18   67000  322    208    5 520   41.9  19.0  13.0   7.0  10.0  27.0  12.0  10.0  20.0   1.0   6.50
19   70000  150    467    5 520   41.9  11.5   7.0   6.0   2.5  13.0   8.5   8.5   8.5    .0   6.50
20   33750  154    219    5 520   41.9  18.0  12.5   3.0  12.5  23.5  12.5   4.5  12.5   1.0   6.50
21   25000  160    156    4 520   41.9  16.5  11.0   5.0  14.0  23.0  16.5   5.5  19.5   4.0   6.50
22   59000  160    369    4 520   41.9  15.0   9.0   1.0    .0  15.0   9.0   1.0  12.0    .0   6.50
23   11500  115    100    4 520   41.9  27.0  23.5  10.0   9.0  33.5  30.0  17.0  33.0   6.0   6.50
24   11600  142     73    4 520   41.9  22.0  17.0  10.0   9.0  29.0  25.0  10.0  25.0   2.5   6.50
25   16000  160    100    5 520   41.9  25.0  20.0   6.0   1.5  26.5  22.0   7.5  25.0   3.0   6.50
26   42000  320    131    5 520   41.9  20.0  14.5   8.0   4.0  25.5  22.5  13.5  22.5   1.0   6.50
27   48700   50    974    6 520   41.9  13.0   8.5   4.5   2.5  14.5  10.0   7.0  10.0    .0   6.50
28   37500  240    156    6 520   41.9  18.0  10.0   3.0   2.0  20.0  10.0   3.0  13.0   1.0   6.50
29   12200  160     76    6 520   41.9  18.0  13.0   5.0   5.5  22.5  18.0   5.5  18.0   1.0   6.50
30   64000  160    400    6 520   41.9  10.0   5.0    .5   2.0  10.0   5.0   1.0   5.0    .0   6.50
31   62720  157    399    6 520   41.9  10.0   5.0    .5   2.0  10.0   5.0   1.0   5.0    .0   6.50
32   12000   80    150    6 520   41.9  11.0   5.0   5.0   5.0  15.0   8.0   9.0    .0   2.0   6.50
33   31000  160    194    6 520   41.9  15.5  10.5   7.0  12.0  17.0  10.0   6.0  13.0   4.0   6.50
34   13070   18    726    6 520   41.9   7.0    .0  11.0   6.0   7.0    .0  11.0   3.0    .0   6.50
35   32000  160    200    7 520   41.9  25.5  20.0   5.0  12.5  23.0  21.0   7.0  24.0   3.0   6.50
36   13000   80    163    7 520   41.9  17.5  12.0  11.0  11.5  26.0  20.5  11.5  23.5   1.0   6.50
37   23000  320     72    7 520   41.9  14.0   7.0   4.0   5.5  15.0   7.0  10.0  10.0   1.5   6.50
38   45000  320    141    7 520   41.9  22.5  19.0   4.0   2.0  25.0  20.0   5.0  23.0   4.0   6.50
39    8000   80    100    8 520   41.9  28.5  22.0   6.0  18.5  38.5  32.5   8.5  35.5   6.0   6.50
40   10000   68    147    8 520   41.9  14.0  10.0   7.0    .0  16.0  11.5   9.5  11.5   1.0   6.50
41   16000   39    410    8 520   41.9  13.0   8.5   5.0   3.5  16.5  12.0   7.0  12.0   1.5   6.50
42   40000  161    248    8 520   41.9  19.0  13.0   7.0  10.0  27.0  12.0  10.0  20.0   1.0   6.50
43   20000  160    125    9 520   41.9  19.0  14.5  12.5   1.0  19.5  15.0  13.5  15.5    .0   6.25
44  125000  316    396    9 520   41.9  27.0  23.0   6.5   9.0  28.0  25.0   5.0  28.0   3.0   6.25
45   75000   78    962   10 520   41.9  20.5  16.0  15.0  16.5  21.0  16.5  14.5  16.5    .0   6.00
46   21500  160    134   10 520   41.9  28.5  22.0   6.0  18.5  38.5  32.5   8.5  35.5   6.0   6.50
47   10000  160     63   11 520   41.9  28.5  23.5  10.5   8.5  34.5  29.5  14.5  30.5  14.5   6.00
48   15600  156    100   11 520   41.9  30.5  23.5   7.0  14.5  39.0  32.5  11.0  35.5   6.0   6.00
49   20000  160    125   11 520   41.9  14.5  10.0   3.0   2.0  16.0   9.0   4.0   9.0   1.5   6.00
50    4570   21    218   11 520   41.9   7.5   3.0   7.0   2.0  11.0   3.5    .0   3.0    .0   6 00
51   20000   40    500   12 520   41.9  14.0   9.0   5.0   4.0  18.0  12.5   7.0  12.5   3.0   6.00
```

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
52	35000	160	219	13	536	43.8	13.0	7.5	9.0	8.5	15.0	11.0	12.0	11.0	2.0	6.00
53	24000	160	150	15	536	43.8	17.5	12.0	1.0	9.0	23.5	18.0	2.0	21.0	1.0	6.00
54	51000	80	638	15	536	43.8	17.5	12.0	11.0	6.0	23.0	18.5	16.5	18.5	.0	6.00
55	51000	95	537	15	536	43.8	8.0	3.0	4.0	3.0	9.0	4.0	5.0	5.0	1.0	6.00
56	45000	156	288	16	536	43.8	9.5	11.5	6.0	3.0	13.0	8.0	6.0	8.0	2.0	6.00
57	35000	160	219	16	536	43.8	26.0	22.5	6.0	16.5	36.5	30.5	7.0	33.5	5.0	6.00
58	67000	317	211	15	536	43.8	14.0	9.5	6.0	1.5	14.5	14.0	7.5	17.0	4.0	6.00
59	35000	160	219	16	536	43.8	28.0	19.0	18.5	21.0	39.0	34.5	21.5	37.5	3.5	6.00
60	50000	134	373	16	536	43.8	18.5	12.0	6.0	6.0	22.5	16.5	6.5	16.5	2.0	6.00
61	40000	30	1333	16	536	43.8	16.5	7.0	8.0	8.0	8.0	6.0	8.0	20.0	3.0	6.00
62	15000	150	100	17	536	43.8	25.5	18.5	20.0	18.0	38.0	30.0	23.0	33.0	5.5	6.00
63	6500	159	41	17	536	43.8	37.0	28.0	5.0	28.0	41.0	35.0	7.0	40.0	7.0	6.00
64	27500	160	172	16	536	43.8	25.0	21.0	10.0	9.0	30.5	26.0	11.0	29.0	4.0	6.00
65	16000	160	100	17	536	43.8	18.0	13.5	6.0	5.0	21.0	16.0	7.0	19.0	6.0	6.00
66	47000	155	303	17	536	43.8	13.5	5.0	2.5	4.5	16.0	7.0	4.0	14.0	1.0	6.00
67	6000	160	38	17	536	43.8	27.0	18.0	14.0	15.0	40.0	31.0	16.0	34.0	14.0	6.00
68	7500	20	375	17	536	43.8	22.0	14.0	1.0	13.0	33.0	25.0	1.0	28.0	.5	6.00
69	2746	160	17	18	536	43.8	33.0	26.0	3.0	28.0	36.0	29.0	6.0	33.0	2.0	6.00
70	19500	320	61	18	536	43.8	26.0	18.5	5.0	11.0	26.0	16.0	5.0	19.0	4.0	6.00
71	18715	20	936	18	536	43.8	9.0	1.5	.0	3.0	9.0	1.5	.0	6.0	.0	6.00
72	30000	160	188	13	536	43.8	23.0	16.0	9.0	7.5	27.5	23.5	21.5	23.5	2.0	6.00
73	7500	80	94	13	536	43.8	26.5	18.0	8.0	4.0	29.0	20.0	10.0	23.0	6.0	6.00
74	50000	160	313	14	536	43.8	12.5	3.0	2.0	7.0	19.5	9.0	3.0	12.0	1.0	6.00
75	80000	157	510	13	536	43.8	15.5	8.5	8.0	8.8	17.0	10.0	8.0	13.0	1.0	6.00
76	30000	160	188	19	536	43.8	28.0	20.0	11.0	7.0	29.0	22.0	5.0	25.0	5.0	6.00
77	16800	80	210	20	536	43.8	19.5	11.0	6.0	7.0	25.5	17.5	11.0	20.5	3.0	6.00
78	6500	80	81	21	536	43.8	28.5	20.5	10.0	5.0	33.0	22.0	17.0	25.0	9.0	6.00
79	40000	149	268	20	536	43.8	13.0	5.5	4.0	8.0	15.0	3.0	4.5	6.0	1.0	6.00
80	9000	101	89	20	536	43.8	21.0	11.0	3.0	20.0	22.0	11.0	3.0	14.0	1.5	6.00
81	8000	160	50	22	536	43.8	10.0	4.0	3.0	7.0	11.0	5.0	7.0	7.0	1.0	6.00
82	15000	55	273	21	536	43.8	20.5	13.0	4.0	18.0	22.0	14.0	4.5	17.0	1.0	6.00
83	16000	80	200	22	536	43.8	17.0	13.0	2.0	1.0	18.5	13.0	2.0	16.0	1.0	6.00
84	30000	142	211	23	536	43.8	19.0	11.0	8.5	8.5	25.5	19.0	8.5	19.0	2.0	6.00
85	120000	160	750	23	536	43.8	16.5	10.0	6.0	4.5	19.0	10.5	7.0	13.5	6.0	6.00
86	80000	159	503	23	536	43.8	10.0	1.0	1.0	5.0	12.0	1.0	.0	6.5	.0	6.00
87	25000	240	104	23	536	43.8	21.5	14.5	3.0	14.0	23.0	16.0	3.0	19.0	.1	6.00
88	17000	82	207	24	536	43.8	22.0	14.0	3.0	9.0	23.0	18.0	3.0	20.0	1.5	6.00
89	13500	160	84	22	536	43.8	26.0	12.0	7.0	21.0	30.0	21.0	8.0	24.0	6.0	6.00
90	30000	105	286	24	536	43.8	26.0	17.0	19.0	19.0	34.0	25.5	19.0	28.5	6.0	6.00
91	90900	163	558	25	546	47.2	16.0	8.0	9.0	9.0	23.0	16.0	12.0	16.0	.0	6.00
92	30000	153	196	25	546	47.2	28.0	19.0	7.0	17.5	37.5	28.0	8.0	31.0	7.0	6.00
93	23437	150	156	25	546	47.2	22.0	16.5	15.0	8.0	16.0	19.0	18.0	16.0	.0	6.00
94	10000	80	127	26	546	47.2	17.0	9.0	4.0	4.0	19.0	11.0	3.5	14.0	1.0	6.00
95	100000	142	704	26	546	47.2	17.0	10.5	1.0	1.5	19.0	12.0	1.0	12.0	.0	6.00
96	14000	159	88	26	546	47.2	30.0	24.0	11.0	5.5	34.0	28.5	16.0	31.5	11.0	6.00
97	5000	76	66	26	546	47.2	34.0	24.0	11.0	15.0	47.0	40.0	15.0	40.0	11.0	6.00
98	4000	118	34	27	546	47.2	14.0	6.0	3.0	4.0	16.0	5.0	3.0	8.0	1.0	6.00
99	19000	160	119	27	546	47.2	28.5	21.0	8.0	8.0	39.0	33.0	18.0	36.0	5.0	6.00
100	65000	159	409	29	546	47.2	18.0	11.0	11.0	10.0	23.0	18.0	16.0	18.0	.0	7.00
101	6000	74	81	29	546	47.2	11.0	3.5	3.5	1.5	12.0	6.0	7.0	11.0	3.0	7.00
102	9000	80	113	29	546	47.2	23.0	16.0	2.0	10.0	28.0	20.0	2.0	23.0	1.0	7.00

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
103	4000	160	25	28	546	47.2	16.0	8.5	5.0	5.0	17.0	10.0	7.0	13.0	2.0	6.50
104	40000	158	253	30	546	47.2	21.0	13.0	3.0	3.0	25.0	17.0	3.0	20.0	2.0	7.75
105	20000	159	126	29	546	47.2	24.0	15.5	9.0	11.0	32.0	23.0	11.0	28.0	8.0	7.00
106	264000	397	665	27	546	47.2	21.5	15.0	1.0	1.0	22.0	16.0	6.0	19.0	.0	6.00
107	35275	160	220	27	546	47.2	21.0	14.0	2.0	15.0	22.0	11.0	3.0	14.0	2.0	6.00
108	10000	160	63	28	546	47.2	30.5	23.0	10.0	13.0	34.0	24.0	11.0	27.0	9.0	6.50
109	88000	320	275	28	546	47.2	17.5	8.5	3.0	7.0	23.5	15.0	6.0	18.0	2.0	6.50
110	20000	156	128	28	546	47.2	23.0	16.0	4.0	11.0	24.0	14.0	6.0	17.0	4.0	6.50
111	40000	160	250	30	546	47.2	23.5	16.0	7.0	4.5	29.5	24.5	4.5	27.5	4.0	7.75
112	19000	159	119	27	546	47.2	19.0	15.0	1.0	1.0	21.0	17.0	1.0	20.0	1.0	6.00
113	25000	160	156	31	546	47.2	23.5	16.0	3.0	16.5	25.0	18.0	3.0	21.0	3.0	7.75
114	40000	160	250	31	546	47.2	24.0	16.0	1.5	18.0	31.0	24.0	2.0	27.0	1.0	7.75
115	15000	160	94	31	546	47.2	32.0	23.0	16.0	16.0	46.0	38.0	31.0	41.0	13.0	7.75
116	16000	160	100	31	546	47.2	28.5	25.0	10.0	12.0	37.0	32.0	12.0	35.0	8.0	7.75
117	25000	118	212	31	546	47.2	20.0	11.0	3.0	16.0	20.0	17.0	11.0	22.0	3.0	7.75
118	25000	160	156	31	546	47.2	30.0	24.0	3.0	5.0	31.0	25.0	6.0	28.0	3.0	7.75
119	80000	320	250	30	546	47.2	8.0	3.5	2.0	1.5	8.0	3.5	2.0	3.5	2.0	7.75
120	15000	113	133	31	546	47.2	22.0	13.0	14.0	14.0	30.0	17.0	16.0	25.0	3.0	7.75
121	23000	160	143	30	546	47.2	21.0	17.0	13.0	11.5	25.0	20.0	16.0	23.0	13.0	7.75
122	55000	281	196	30	546	47.2	28.0	22.5	7.0	9.0	31.0	24.0	8.0	27.0	6.5	7.75
123	16000	101	158	30	546	47.2	26.0	19.0	5.0	16.0	30.0	20.0	6.0	23.0	1.0	7.75
124	18000	120	150	30	546	47.2	14.0	7.0	2.0	16.0	15.0	8.0	2.0	11.0	1.0	7.75
125	31000	160	194	32	546	47.2	18.0	14.0	5.0	4.0	20.0	16.0	7.0	19.0	5.0	8.25
126	17500	79	224	31	546	47.2	17.0	10.0	4.5	5.5	18.0	9.0	6.0	15.0	3.0	7.75
127	13500	80	169	32	546	47.2	27.5	17.5	5.0	17.0	37.0	29.0	6.0	32.0	4.0	8.25
128	8500	80	128	32	546	47.2	21.0	17.5	4.0	3.0	22.0	15.0	4.0	18.0	3.0	8.25
129	75000	160	469	33	546	47.2	14.0	4.0	4.0	10.0	19.0	4.0	6.0	9.0	.0	9.00
130	50000	160	313	33	546	47.2	17.0	9.0	3.0	12.0	20.0	12.0	5.0	15.0	4.0	9.00
131	26000	139	187	34	546	47.2	19.0	12.0	8.0	8.0	24.0	18.0	.0	18.0	2.0	9.00
132	28000	159	176	34	546	47.2	27.0	18.5	9.5	9.5	36.0	27.0	15.0	30.0	8.0	9.00
133	30000	147	204	34	546	47.2	19.0	11.5	3.0	10.0	22.0	15.0	3.0	18.0	.0	9.00
134	6400	156	41	37	560	52.1	20.0	11.0	1.0	2.0	22.0	13.0	2.0	16.0	1.0	9.50
135	25782	160	161	41	560	52.1	15.0	8.5	6.0	5.0	19.0	14.0	8.0	14.0	2.0	11.00
136	30000	160	188	41	560	52.1	12.0	3.0	5.5	8.0	17.0	4.0	6.0	11.0	.0	11.00
137	8000	86	93	40	560	52.1	27.0	19.0	17.0	24.0	36.0	30.0	21.0	30.0	7.0	11.00
138	35000	160	219	40	560	52.1	16.5	7.0	7.0	5.0	17.0	8.0	8.0	14.0	4.0	10.50
139	20000	160	125	40	560	52.1	30.0	22.0	13.0	11.0	40.0	31.0	21.0	34.0	13.0	10.50
140	24000	160	150	39	560	52.1	17.0	8.0	7.0	6.0	21.0	12.0	9.0	15.0	1.0	9.50
141	5000	159	31	39	560	52.1	30.0	22.0	15.0	14.0	34.0	28.0	17.0	31.0	14.0	9.50
142	20000	160	125	40	560	52.1	15.0	9.0	10.0	3.5	21.0	17.0	13.0	17.0	3.0	10.50
143	26700	154	174	41	560	52.1	23.0	17.0	11.0	11.0	30.0	24.0	11.0	24.0	5.0	11.00
144	15000	116	129	41	560	52.1	29.0	23.0	11.0	2.0	31.0	25.0	13.0	28.0	.0	11.00
145	50000	70	714	42	560	52.1	10.5	3.5	5.0	5.0	11.0	4.0	5.0	7.0	3.0	11.00
146	13000	79	165	42	560	52.1	15.0	10.0	4.0	.0	15.0	10.0	4.0	13.0	4.0	11.00
147	20000	159	126	41	560	52.1	35.0	28.0	4.0	26.0	39.0	28.0	4.0	31.0	4.0	11.00
148	55000	160	344	42	560	52.1	19.0	10.0	12.0	12.0	27.0	18.0	11.0	21.0	.0	11.00
149	57000	160	356	43	560	52.1	19.5	9.0	3.5	10.0	26.0	17.0	4.0	20.0	2.0	11.50
150	80000	160	500	44	560	52.1	23.0	18.0	16.0	2.0	23.0	18.0	16.0	18.0	1.0	11.50
151	32800	160	205	43	560	52.1	21.0	12.0	15.0	15.0	30.0	24.0	16.0	27.0	4.0	11.50
152	40000	159	252	44	560	52.1	13.0	6.0	1.0	10.0	14.0	7.0	2.0	10.0	1.0	11.50
153	27900	158	177	44	560	52.1	23.5	16.0	18.0	18.0	35.0	26.0	20.0	29.0	3.0	11.50

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
154	12000	80	150	44	560	52.1	27.0	19.0	8.0	16.0	27.0	17.0	11.0	20.0	7.0	11.50
155	12000	80	150	44	560	52.1	27.0	18.0	8.0	19.0	30.0	20.0	7.0	23.0	4.0	11.50
156	20000	160	125	44	560	52.1	23.0	16.0	7.0	11.0	25.0	18.0	8.0	21.0	3.0	11.50
157	12500	151	83	45	560	52.1	26.5	19.0	7.0	13.0	30.0	22.0	7.0	25.0	6.0	11.50
158	12500	160	78	45	560	52.1	27.0	19.0	7.0	12.0	34.0	27.0	9.0	30.0	7.0	11.50
159	12000	158	76	45	560	52.1	27.0	18.5	8.0	22.0	30.0	21.0	10.0	24.0	4.0	11.50
160	40000	160	250	45	560	52.1	30.0	20.0	15.0	15.0	43.0	35.0	24.0	38.0	12.0	11.50
161	30700	99	310	46	560	52.1	22.0	14.0	1.0	11.0	25.0	17.5	1.0	20.5	1.0	11.50
162	15000	159	94	46	560	52.1	24.0	18.0	19.0	18.0	34.0	28.0	20.0	28.0	4.0	11.50
163	18500	318	58	47	560	52.1	21.0	14.5	4.0	10.0	20.0	12.0	4.0	15.0	4.0	11.00
164	30000	160	188	47	560	52.1	14.0	6.5	6.0	4.0	15.0	8.0	7.0	11.0	1.0	11.00
165	45000	159	283	47	560	52.1	24.5	16.0	2.0	10.0	26.0	18.0	2.0	21.0	2.0	11.00
166	15000	160	94	47	560	52.1	17.5	13.5	7.0	6.0	21.0	16.0	11.0	19.0	7.0	11.00
167	35000	80	438	48	560	52.1	23.0	15.0	5.5	4.0	25.0	18.0	8.0	21.0	5.0	11.00
168	10000	80	125	47	560	52.1	24.5	15.0	4.0	7.0	29.0	20.0	5.0	23.0	3.0	11.00
169	58000	152	382	52	576	57.7	16.0	12.0	2.0	.0	17.0	13.0	2.0	16.0	1.0	9.00
170	62500	150	417	52	576	57.7	30.0	25.0	2.0	3.0	34.0	27.0	2.0	30.0	1.5	9.00
171	78500	156	503	52	576	57.7	15.0	7.0	5.5	3.0	19.0	13.0	14.0	16.0	3.0	9.00
172	76000	160	475	52	576	57.7	20.0	12.0	6.0	5.0	22.0	17.0	10.0	17.0	4.0	9.00
173	65000	160	406	53	576	57.7	27.0	20.0	7.0	2.0	29.0	22.0	9.0	25.0	6.0	9.00
174	19500	80	244	52	576	57.7	31.0	20.0	2.0	24.0	34.0	24.0	4.0	27.0	2.0	9.00
175	72000	159	453	50	576	57.7	27.0	19.0	4.0	10.0	34.0	25.0	4.0	28.0	4.0	9.50
176	69000	159	434	49	576	57.7	15.0	7.0	9.0	7.0	21.0	16.0	15.0	4.0	16.0	10.50
177	123505	609	203	49	576	57.7	27.0	17.0	8.0	19.0	28.0	18.0	8.0	21.0	6.0	10.50
178	22116	100	221	51	576	57.7	17.0	12.0	8.0	8.0	22.0	16.0	12.0	16.0	3.0	9.00
179	52000	158	329	51	576	57.7	19.0	12.0	3.0	7.0	20.0	13.0	3.0	16.0	3.0	9.00
180	15150	79	192	52	576	57.7	13.5	5.0	5.0	.5	14.0	5.0	5.0	8.0	2.0	9.00
181	73350	160	458	49	576	57.7	26.0	18.5	6.0	8.0	26.0	18.5	9.0	21.5	6.0	10.50
182	65000	80	812	55	576	57.7	7.0	1.0	.5	.5	8.0	1.0	1.0	1.0	.5	9.00
183	46500	160	291	54	576	57.7	30.0	26.0	14.0	12.0	38.0	30.0	18.0	34.0	13.0	9.00
184	32000	80	400	54	576	57.7	12.0	7.0	4.0	4.0	13.0	9.0	4.0	12.0	2.0	9.00
185	30000	160	188	55	576	57.7	31.0	27.0	24.0	5.0	35.0	27.0	16.0	30.0	23.0	9.00
186	32000	154	208	55	576	57.7	18.0	12.0	3.0	7.0	25.0	20.0	5.0	20.0	3.0	9.00
187	35000	160	209	55	576	57.7	23.0	19.0	7.0	6.5	27.0	22.0	7.0	25.0	6.5	9.00
188	18209	160	114	56	576	57.7	11.0	6.0	3.0	4.0	12.0	8.0	4.0	11.0	2.0	9.00
189	80000	159	503	56	576	57.7	27.0	19.0	14.0	16.0	40.0	43.0	15.0	46.0	8.0	9.00
190	151111	224	675	56	576	57.7	18.0	10.0	.5	.5	19.0	10.0	.5	13.0	.5	9.00
191	90000	153	588	57	576	57.7	25.0	18.0	18.0	19.0	38.0	28.0	18.0	31.0	2.0	9.75
192	35000	80	438	57	576	57.7	17.0	13.0	9.0	2.0	18.0	14.0	10.0	17.0	3.0	9.75
193	60000	160	375	58	576	57.7	23.0	14.0	13.0	14.0	34.0	26.0	14.0	29.0	6.0	9.75
194	50000	160	313	59	576	57.7	23.0	19.0	7.0	6.0	27.0	22.0	8.0	25.0	7.0	9.75
195	45000	160	281	59	576	57.7	23.0	19.0	6.0	5.0	26.0	21.0	7.0	24.0	6.0	9.75
196	48000	160	300	59	576	57.7	29.0	24.0	10.0	3.0	32.0	27.0	13.0	30.0	8.0	9.75
197	30000	160	188	58	576	57.7	21.0	14.0	8.0	16.0	28.0	20.0	9.0	23.0	1.0	9.75
198	41600	157	265	58	576	57.7	31.0	23.0	4.0	18.0	38.0	28.0	4.0	33.0	3.0	9.75
199	36000	79	456	59	576	57.7	30.0	24.0	9.0	17.0	34.0	24.0	12.0	27.0	4.0	9.75
200	55500	111	500	60	576	57.7	17.0	10.0	6.0	7.0	17.0	10.0	7.0	13.0	2.0	9.75
201	58000	76	763	60	576	57.7	19.0	13.0	20.0	12.0	26.0	21.0	26.0	24.0	.0	9.75
202	37500	80	469	60	576	57.7	15.0	7.0	9.0	12.0	22.0	16.0	6.0	16.0	2.0	9.75
203	60000	160	375	60	576	57.7	24.0	15.0	7.0	18.0	32.0	24.0	10.0	24.0	5.0	9.75
204	15000	75	200	60	576	57.7	23.0	17.0	4.0	.0	23.0	18.0	4.0	21.0	3.0	9.75

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
205	60000	60	1000	90	633	74.1	23.0	21.0	15.0	26.0	31.0	14.0	22.0	24.0	3.0	9.25
206	340000	160	2125	90	633	74.1	17.5	13.0	9.0	1.5	18.0	13.5	10.0	13.0	.0	9.25
207	115976	152	763	87	633	74.1	21.0	14.0	14.0	6.0	26.0	22.0	18.0	22.0	3.0	8.75
208	19256	157	123	94	633	74.1	22.0	15.0	7.0	11.0	32.0	27.0	8.0	27.0	5.0	11.00
209	54968	65	846	89	633	74.1	25.0	18.0	8.0	11.0	34.0	29.0	9.0	29.0	7.0	9.25
210	131440	80	1643	87	633	74.1	17.5	12.0	9.0	6.5	21.5	17.0	13.0	17.0	.0	8.75
211	89976	130	692	89	633	74.1	16.0	9.0	4.0	5.5	20.0	15.0	8.0	15.0	4.0	9.75
212	23923	113	212	88	633	74.1	27.0	19.0	18.0	18.0	39.0	31.0	18.0	34.0	2.0	9.25
213	39868	291	137	88	633	74.1	32.0	23.5	17.0	16.0	40.0	32.0	20.0	35.0	17.0	9.25
214	59961	79	759	86	633	74.1	26.0	17.0	14.0	14.0	35.0	27.0	14.0	30.0	14.0	8.25
215	59961	79	759	86	633	74.1	19.0	11.0	15.0	15.0	27.0	20.0	21.0	23.0	2.0	8.25
216	23520	160	147	89	633	74.1	27.0	19.0	10.0	11.0	36.0	28.0	15.0	31.0	10.0	9.25
217	30000	80	375	89	633	74.1	26.0	19.0	7.0	6.0	29.0	22.0	8.0	25.0	5.0	9.25
218	241121	239	1009	93	633	74.1	19.0	11.0	3.0	4.0	23.0	16.0	4.0	19.0	2.0	10.25
219	160000	160	1000	86	633	74.1	22.0	14.0	6.0	5.0	27.0	19.0	7.0	22.0	4.0	8.25
220	80000	80	1000	90	633	74.1	18.5	11.0	2.0	2.0	20.0	13.0	2.0	16.0	2.0	9.25
221	60000	80	750	93	633	74.1	27.0	19.0	8.0	2.0	29.0	21.0	10.0	24.0	6.0	10.25
222	159360	160	996	94	633	74.1	25.0	17.0	7.0	2.0	27.0	19.0	7.0	22.0	5.0	11.00
223	23606	29	814	91	633	74.1	24.0	16.0	4.0	1.0	25.0	17.0	5.0	20.0	2.0	9.25
224	40000	80	500	95	633	74.1	31.0	23.0	13.0	11.0	40.0	32.0	21.0	35.0	13.0	11.50
225	99932	80	1249	93	633	74.1	20.0	11.0	4.0	12.0	27.0	19.0	4.0	22.0	4.0	10.25
226	83928	78	1075	94	633	74.1	34.0	25.0	18.0	12.0	42.0	32.0	24.0	35.0	10.0	11.00
227	114943	79	1455	95	633	74.1	23.0	13.0	7.0	11.0	30.0	23.0	10.0	26.0	4.0	11.50
228	124972	156	801	87	633	74.1	22.0	13.0	6.0	13.0	29.0	22.0	9.0	25.0	5.0	8.75
229	34997	79	443	86	633	74.1	34.5	25.0	11.0	16.0	46.0	38.0	16.0	41.0	11.0	8.25
230	99982	158	633	87	633	74.1	20.0	11.0	11.0	11.0	27.0	21.0	11.0	21.0	.0	8.75
231	195908	164	1195	92	633	74.1	19.0	11.0	10.0	10.0	26.0	20.0	10.0	20.0	2.0	9.75
232	19980	76	263	89	633	74.1	18.0	13.0	2,0	2.5	21.0	11.5	3.0	11.5	1.0	9.25
233	39975	59	677	89	633	74.1	32.0	24.0	14.0	22.0	38.0	28.0	20.0	31.0	5.0	9.25
234	100000	160	625	90	633	74.1	27.0	19.0	6.0	18.0	30.0	23.0	8.0	26.0	4.0	9.25
235	62480	80	781	87	633	74.1	20.5	13.0	1.0	14.0	25.0	14.0	2.0	17.0	.0	8.75
236	100000	160	625	90	633	74.1	20.5	13.0	1.0	14.0	25.0	14.0	1.0	17.0	.0	9.25
237	30400	160	190	91	633	74.1	22.5	15.0	1.5	11.0	27.0	19.5	2.0	22.0	1.0	9.25
238	59947	80	749	85	633	74.1	31.0	24.0	11.0	11.0	35.0	28.0	11.0	31.0	8.0	8.25
239	44881	158	284	88	633	74.1	17.5	10.0	6.0	7.0	17.5	10.0	7.0	13.0	2.0	9.25
240	149920	160	937	93	633	74.1	27.0	20.0	3.0	3.5	30.0	23.0	4.0	26.0	2.0	10.25
241	124974	159	786	94	633	74.1	26.0	19.0	4.0	7.0	26.0	19.0	6.0	22.0	4.0	11.00
242	49920	160	312	86	633	74.1	27.0	20.0	3.0	3.5	30.0	23.0	4.0	26.0	2.0	8.25
243	159870	160	999	88	633	74.1	13.0	5.0	4.0	2.0	15.0	10.0	8.0	13.0	4.0	9.25
244	115947	117	991	95	633	74.1	17.0	10.0	3.0	1.0	18.0	11.0	4.0	21.0	2.0	11.50
245	79999	80	1000	92	633	74.1	9.0	4.0	2.0	3.0	11.0	5.0	3.0	8.0	1.0	9.75
246	69925	79	885	95	633	74.1	17.0	13.0	9.0	6.5	20.0	13.0	10.0	16.0	6.0	11.50
247	51847	158	328	96	633	74.1	20.0	18.0	8.0	7.5	27.0	20.0	16.0	20.0	4.0	11.50
248	79971	146	548	86	633	74.1	23.5	19.0	12.0	12.0	29.0	23.0	15.0	26.0	4.0	8.25
249	40000	320	125	89	633	74.1	30.0	26.0	14.0	13.0	38.0	23.0	19.0	26.0	9.0	9.25
250	214960	155	1387	119	677	88.9	22.0	17.0	14.0	2.0	24.0	20.0	17.0	20.0	.0	13.75
251	299992	160	1875	111	677	88.9	16.5	12.0	8.0	.0	17.0	14.0	10.0	17.0	.0	15.75
252	50000	80	625	117	677	88.9	14.0	7.0	8.0	4.0	20.0	15.5	11.0	15.5	3.0	12.25
253	560000	160	3500	109	677	88.9	18.0	10.0	2.0	8.5	20.0	12.0	1.0	15.0	.5	15.00
254	79923	78	1025	110	677	88.9	14.5	5.0	15.0	12.0	23.0	13.0	18.0	17.0	.0	15.00
255	299963	160	1874	115	677	88.9	11.0	4.0	5.0	8.0	18.0	13.0	9.0	13.0	.0	12.25

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
256	29960	77	389	114	677	88.9	10.0	3.0	7.0	2.0	13.0	3.0	6.0	6.0	3.0	13.25
257	58981	84	702	113	677	88.9	10.0	3.0	7.0	2.0	13.0	3.0	6.0	5.0	3.0	13.75
258	12249	53	231	117	677	88.9	10.0	2.0	8.0	.5	10.0	2.0	8.0	5.0	2.0	12.25
259	299921	145	2068	119	677	88.9	28.5	20.0	10.0	10.0	39.0	26.0	14.0	29.0	8.0	13.75
260	64000	80	800	111	677	88.9	25.0	16.0	8.0	10.0	33.0	25.0	11.0	28.0	6.0	15.75
261	79903	158	506	111	677	88.9	25.5	16.0	8.0	9.5	31.0	23.0	10.0	26.0	6.0	15.75
262	199991	78	2564	113	677	88.9	15.0	5.0	12.0	10.0	22.0	15.0	16.0	18.0	3.0	13.75
263	314880	160	1968	113	677	88.9	28.5	21.5	8.5	7.0	32.0	24.0	12.0	27.0	7.0	13.75
264	199940	77	2597	117	677	88.9	19.5	12.0	4.5	5.0	26.0	17.0	7.0	20.0	1.0	12.25
265	100000	160	625	115	677	88.9	27.0	19.0	6.0	3.0	28.0	20.0	7.0	23.0	5.5	12.25
266	20000	80	250	113	677	88.9	19.0	11.0	4.0	3.0	22.0	14.0	4.0	17.0	2.0	13.75
267	144960	160	906	109	677	88.9	32.0	24.0	13.0	5.0	36.0	28.0	16.0	31.0	11.0	15.00
268	186960	80	2337	112	677	88.9	30.0	22.0	11.0	4.5	33.0	26.0	13.0	29.0	11.0	16.75
269	26000	80	325	113	677	88.9	30.0	22.0	12.0	5.0	34.0	26.0	14.0	29.0	10.0	13.75
270	58720	80	734	110	677	88.9	26.0	17.0	9.0	6.0	31.0	23.0	12.0	26.0	4.0	15.00
271	174960	80	2187	112	677	88.9	19.0	9.0	2.0	11.0	26.0	17.0	4.0	20.0	2.0	16.75
272	124960	160	781	114	677	88.9	26.5	17.0	3.0	15.0	35.0	27.0	5.0	30.0	2.0	13.25
273	159887	157	1018	110	677	88.9	19.0	10.0	4.0	11.0	26.0	19.0	5.5	22.0	2.0	15.00
274	66000	150	440	112	677	88.9	16.5	10.0	2.0	2.0	18.0	10.0	2.0	10.0	1.0	16.75
275	40000	80	500	113	677	88.9	7.0	1.0	9.0	1.0	7.0	1.0	10.0	1.0	1.0	13.75
276	72000	160	450	118	677	88.9	22.0	15.0	5.0	17.0	26.0	16.0	6.0	19.0	4.0	12.75
277	14960	80	187	120	677	88.9	31.0	23.0	4.0	18.0	39.0	30.0	4.0	33.0	3.0	18.25
278	314980	157	2006	111	677	88.9	14.0	6.0	8.0	11.0	16.0	7.0	9.0	10.0	4.0	15.75
279	320000	160	2000	110	677	88.9	15.0	6.5	6.0	13.0	17.0	7.0	7.0	10.0	3.0	15.00
280	126400	158	800	115	677	88.9	21.0	14.0	2.0	12.0	23.0	16.0	2.0	19.0	1.0	12.25
281	144880	145	1000	113	677	88.9	25.0	17.0	5.0	15.0	28.0	20.0	8.0	23.0	1.0	13.75
282	239932	133	1804	114	677	88.9	25.0	17.0	5.0	15.0	28.0	20.0	8.0	23.0	1.0	13.25
283	192000	160	1200	111	677	88.9	22.0	16.0	3.0	1.0	23.0	17.0	5.0	20.0	2.0	15.75
284	199847	155	1289	120	677	88.9	27.0	21.0	8.0	.0	27.0	21.0	8.0	24.0	2.0	18.25
285	170966	171	1000	109	677	88.9	16.0	10.0	8.0	8.0	19.0	14.0	10.0	17.0	2.0	15.00
286	120000	80	1500	114	677	88.9	18.0	14.0	5.0	4.0	22.0	17.0	6.0	20.0	4.0	13.25
287	74897	154	516	111	677	88.9	30.0	25.0	12.0	9.0	36.0	29.0	17.0	32.0	11.0	15.75
288	74960	80	937	114	677	88.9	31.0	26.0	7.5	5.0	35.0	29.0	15.0	32.0	7.0	13.25
289	99940	76	1315	120	677	88.9	21.0	16.0	8.0	9.0	27.0	21.0	11.0	21.0	2.0	18.25
290	79212	80	990	121	716	100.0	21.5	15.0	14.0	14.0	32.0	28.0	23.0	28.0	.5	18.25
291	320000	160	2000	124	716	100.0	23.0	18.0	14.0	5.0	26.0	19.0	15.0	19.0	.5	18.25
292	109984	158	696	130	716	100.0	27.0	20.0	8.0	17.5	31.0	24.0	12.0	27.0	4.0	20.00
293	319982	155	2064	127	716	100.0	31.5	25.0	13.0	20.0	33.0	29.0	15.0	32.0	8.0	21.00
294	461900	149	3100	122	716	100.0	19.0	12.0	2.0	9.5	21.0	14.0	3.0	17.0	1.0	18.25
295	99995	40	2500	121	716	100.0	14.0	4.5	10.0	7.0	19.0	11.0	13.0	14.0	3.0	18.25
296	131440	80	1643	123	716	100.0	28.0	19.0	13.0	14.0	37.0	28.0	17.0	31.0	8.0	17.75
297	99932	158	632	131	716	100.0	20.5	11.5	7.0	11.0	29.0	20.0	10.0	23.0	3.0	17.25
298	223989	159	1409	124	716	100.0	19.0	9.0	11.0	13.0	28.0	19.0	17.0	22.0	.5	18.25
299	333760	160	2086	126	716	100.0	26.0	17.0	9.0	11.0	33.0	25.0	14.0	28.0	7.0	20.00
300	259910	158	1645	126	716	100.0	26.0	17.0	9.0	11.0	33.0	25.0	14.0	28.0	7.0	20.00
301	249939	158	1582	129	716	100.0	23.0	14.5	4.0	.5	23.5	15.0	4.5	18.0	2.0	21.25
302	93931	79	1189	131	716	100.0	33.0	23.5	10.5	9.0	40.0	31.0	10.0	34.0	10.0	17.25
303	269909	153	1764	127	716	100.0	25.5	18.0	3.0	12.0	32.0	23.0	4.0	26.0	1.5	21.00
304	303040	160	1894	127	716	100.0	20.0	13.0	5.0	12.0	25.0	18.0	6.0	21.0	3.5	21.00
305	324012	81	4000	125	716	100.0	16.0	7.5	4.0	4.0	20.0	11.0	8.0	14.0	2.0	19.50
306	104935	78	1345	125	716	100.0	14.0	8.0	6.0	6.0	19.0	12.0	10.0	12.0	.5	19.50

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
307	99983	30	3333	125	716	100.0	17.0	11.0	5.0	5.0	21.0	15.0	5.0	15.0	2.0	19.50
308	80000	80	1000	121	716	100.0	18.0	12.0	6.5	6.5	23.0	17.0	6.5	17.0	1.0	18.25
309	127429	75	1699	132	716	100.0	20.0	14.0	4.0	3.0	22.0	15.0	5.0	15.0	3.0	17.25
310	224978	158	1424	121	716	100.0	23.0	15.0	5.0	17.0	25.0	18.0	8.0	21.0	4.0	18.25
311	70000	80	875	131	716	100.0	28.0	20.0	7.0	16.0	32.0	24.0	9.0	27.0	2.0	17.25
312	19998	48	417	127	716	100.0	28.0	20.0	7.0	17.0	32.0	24.0	9.0	27.0	3.0	21.00
313	71926	79	910	128	716	100.0	30.0	22.0	10.0	20.0	35.0	27.0	12.0	30.0	5.0	22.75
314	89982	77	1169	125	716	100.0	31.0	23.0	11.0	21.0	36.0	28.0	13.0	31.0	6.0	19.50
315	89982	117	769	125	716	100.0	31.0	23.0	11.0	21.0	36.0	28.0	13.0	31.0	6.0	19.50
316	416970	139	3000	125	716	100.0	20.5	12.0	2.5	15.0	21.0	13.0	3.0	16.0	2.0	19.50
317	174944	80	2187	131	716	100.0	23.0	16.0	4.0	14.0	25.0	16.0	3.0	19.0	2.5	17.25
318	400000	160	2500	128	716	100.0	21.0	14.0	3.0	13.0	23.0	14.0	1.5	17.0	1.0	22.75
319	157896	158	993	131	716	100.0	15.0	7.5	5.0	4.0	20.0	14.0	8.0	17.0	3.5	17.25
320	169966	80	2125	131	716	100.0	22.5	17.5	7.0	5.0	25.0	17.0	13.0	20.0	5.0	17.25
321	20000	80	250	124	716	100.0	18.0	11.5	4.0	2.5	19.0	12.0	5.0	15.0	3.0	18.25
322	70960	80	887	127	716	100.0	30.5	23.0	13.0	3.0	34.0	26.0	15.0	29.0	2.0	21.00
323	89920	160	562	128	716	100.0	29.5	22.0	10.0	2.0	32.0	26.0	13.0	28.0	4.0	22.75
324	129948	68	1911	123	716	100.0	15.0	8.0	7.0	7.0	20.5	14.0	10.0	14.0	1.0	17.75
325	134935	135	1000	126	716	100.0	13.0	7.0	5.0	3.5	15.0	8.0	6.0	11.0	3.0	20.00
326	99852	159	628	129	716	100.0	20.0	14.0	3.0	3.0	25.0	18.0	3.0	21.0	3.0	21.25
327	84960	160	531	130	716	100.0	23.0	19.0	6.0	5.0	27.0	20.0	8.0	23.0	5.0	20.00
328	176218	126	1399	128	716	100.0	22.0	16.0	11.0	11.0	31.0	25.0	11.0	25.0	2.0	22.75
329	185984	128	1453	130	716	100.0	30.0	25.0	15.0	15.0	38.0	33.0	19.0	36.0	15.0	20.00
330	24990	105	238	130	716	100.0	29.0	25.0	13.0	12.0	37.0	32.0	18.0	35.0	8.0	20.00
331	79948	158	506	124	716	100.0	31.0	26.0	15.0	12.0	38.0	32.0	20.0	35.0	14.0	18.25
332	89996	151	596	131	716	100.0	31.0	26.0	15.0	15.0	41.0	34.0	22.0	37.0	16.0	17.25
333	58360	98	598	138	728	111.0	22.5	14.0	15.0	18.0	29.0	24.0	20.0	24.0	.5	18.25
334	120353	146	824	144	728	111.0	19.0	14.5	10.0	.5	20.0	15.0	10.0	15.0	.5	12.50
335	194880	160	1218	143	728	111.0	17.0	9.0	9.0	9.0	22.0	18.0	15.0	18.0	.5	13.00
336	380000	152	2500	144	728	111.0	17.0	6.0	3.0	7.0	20.0	7.0	3.0	12.0	3.0	12.50
337	479940	160	3000	138	728	111.0	11.0	2.0	3.0	6.5	12.0	4.0	5.0	7.0	.5	18.25
338	86804	157	549	135	728	111.0	25.0	14.0	18.0	19.0	39.0	28.0	19.0	31.0	2.0	17.00
339	99879	160	624	143	728	111.0	28.0	17.0	12.0	13.0	38.0	27.0	18.0	32.0	9.0	13.00
340	475873	158	3012	141	728	111.0	21.0	11.0	3.0	4.0	24.0	14.0	4.0	19.0	2.0	15.00
341	240000	160	1500	135	728	111.0	24.0	13.0	5.0	1.0	25.0	14.0	6.0	19.0	3.0	17.00
342	26640	80	333	137	728	111.0	17.0	6.0	6.0	6.0	20.0	9.5	9.0	14.5	4.0	17.00
343	154939	79	1961	136	728	111.0	32.0	20.0	15.0	9.0	40.0	29.0	20.0	34.0	10.0	17.00
344	100000	160	625	143	728	111.0	27.5	16.5	9.0	3.0	30.0	19.0	10.0	24.0	8.0	13.00
345	24000	80	300	143	728	111.0	28.0	17.0	12.0	8.0	34.5	24.0	15.0	29.0	10.0	13.00
346	311926	153	2039	137	728	111.0	24.0	12.0	7.0	5.0	28.0	18.0	8.0	23.0	6.0	17.00
347	499880	158	3164	136	728	111.0	24.0	12.0	9.0	16.0	33.0	24.0	11.0	26.0	6.0	17.00
348	209960	80	2625	135	728	111.0	17.0	7.0	9.0	9.0	24.0	16.0	11.0	18.0	.5	17.00
349	99998	79	1266	134	728	111.0	18.0	10.0	5.0	5.0	21.0	13.0	5.0	15.0	2.0	16.50
350	57786	75	770	137	728	111.0	8.5	10.0	2.0	2.0	19.0	10.0	2.0	12.0	1.0	17.00
351	99839	80	1249	137	728	111.0	20.0	11.0	4.0	4.0	23.0	15.0	7.0	17.0	1.0	17.00
352	160000	160	1000	140	728	111.0	22.0	7.0	5.0	15.0	24.0	11.0	6.0	16.0	4.0	16.00
353	99852	157	636	137	728	111.0	20.0	7.0	1.0	13.0	21.0	8.0	2.0	13.0	1.0	17.00
354	240000	80	3000	137	728	111.0	19.0	7.0	5.0	7.0	19.0	11.0	7.0	12.0	3.0	17.00
355	320000	160	2000	138	728	111.0	13.0	7.0	5.0	1.0	14.0	8.0	6.0	11.0	3.0	18.25
356	161400	81	1993	137	728	111.0	16.0	9.5	8.0	3.0	19.0	12.5	11.0	15.5	5.0	17.00
357	154960	80	1937	144	728	111.0	17.0	10.0	3.0	.5	18.0	11.0	3.0	13.0	1.0	12.50

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
358	399923	157	2547	137	728	111.0	17.0	10.0	3.0	.5	18.0	11.0	3.0	13.0	1.0	17.00
359	200907	70	2871	136	728	111.0	19.0	13.0	12.0	9.0	23.0	17.0	15.0	19.0	6.0	17.00
360	100000	80	1250	135	728	111.0	14.5	8.0	7.0	6.0	18.0	12.0	10.0	14.0	6.0	17.00
361	189920	160	1187	144	728	111.0	22.0	15.5	11.0	10.0	26.0	20.0	13.0	23.0	10.0	12.50
362	200000	320	625	97	652	80.7	20.0	13.0	8.0	6.0	25.0	20.0	10.0	20.0	3.0	12.00
363	102983	75	1373	101	652	80.7	16.5	9.0	10.0	12.0	25.0	17.5	19.0	22.0	.5	12.00
364	200000	114	1754	99	652	80.7	17.0	11.5	10.0	10.0	25.0	20.0	16.0	20.0	.5	12.00
365	80000	160	500	102	652	80.7	17.0	12.0	9.0	2.0	17.0	12.0	10.0	12.0	.5	12.00
366	224981	157	1433	99	652	80.7	18.0	11.0	10.0	6.0	23.0	19.0	15.0	23.0	1.0	12.00
367	57440	80	718	98	652	80.7	13.0	4.0	10.0	7.0	20.0	11.0	14.0	14.0	2.0	12.00
368	77958	153	510	102	652	80.7	27.0	19.0	18.0	19.0	40.0	32.0	19.0	35.0	4.0	12.00
369	72000	160	450	101	652	80.7	27.0	19.0	20.0	23.0	42.0	36.0	23.0	39.0	3.0	12.00
370	106946	158	677	102	652	80.7	25.0	16.0	18.0	18.0	35.0	28.0	19.0	31.0	5.0	12.00
371	114940	140	821	98	652	80.7	29.0	21.0	11.0	10.0	38.0	31.0	20.0	34.0	8.0	12.00
372	80000	80	1000	103	652	80.7	25.0	17.0	9.0	10.0	34.0	27.0	15.0	30.0	7.0	12.50
373	400000	160	2500	99	652	80.7	16.0	7.0	9.0	8.0	23.0	15.0	13.0	18.0	3.0	12.00
374	349952	140	2500	101	652	80.7	16.0	7.0	11.0	10.0	21.0	13.0	15.0	16.0	4.0	12.00
375	30000	150	200	106	652	80.7	29.0	22.0	10.0	7.0	37.0	30.0	17.0	33.0	7.0	14.75
376	139974	82	1707	107	652	80.7	27.0	19.0	8.0	2.0	29.0	21.0	10.0	24.0	6.0	15.00
377	129839	80	1623	97	652	80.7	21.0	13.0	5.0	4.0	23.0	15.0	5.0	18.0	3.0	12.00
378	97947	88	1113	105	652	80.7	29.0	21.0	10.0	4.0	32.0	24.0	12.0	27.0	7.0	13.00
379	58960	80	737	100	652	80.7	29.0	21.0	11.0	6.0	34.0	26.0	12.0	29.0	8.0	12.00
380	171200	160	1070	107	652	80.7	28.5	20.0	12.0	6.0	33.0	25.0	13.0	28.0	10.0	15.00
381	249920	160	1562	107	652	80.7	25.0	18.0	8.0	5.0	29.0	23.0	9.0	26.0	6.0	15.00
382	249948	159	1572	100	652	80.7	23.0	16.0	5.0	4.0	28.0	22.0	8.0	25.0	4.0	12.00
383	21920	160	137	100	652	80.7	19.0	12.0	4.0	17.0	28.0	21.0	4.0	21.0	3.0	12.00
384	64960	80	812	98	652	80.7	26.5	19.0	10.0	12.0	34.0	27.0	14.0	30.0	4.0	12.00
385	199849	156	1281	97	652	80.7	25.0	17.0	9.0	13.0	32.0	24.0	14.0	27.0	3.0	12.00
386	128688	109	1181	99	652	80.7	24.0	15.0	8.0	11.0	30.0	22.0	12.0	25.0	.5	12.00
387	72930	78	935	99	652	80.7	25.0	16.0	10.0	16.0	34.0	25.0	17.0	28.0	5.0	12.00
388	57496	111	518	105	652	80.7	25.0	18.0	15.0	15.0	35.0	29.0	15.0	30.0	7.0	13.00
389	64988	154	422	105	652	80.7	21.0	14.0	10.0	10.0	28.0	22.0	10.0	22.0	4.0	13.00
390	60000	80	750	104	652	80.7	35.0	27.0	5.0	26.0	40.0	32.0	7.0	35.0	4.0	12.50
391	24960	160	156	98	652	80.7	27.0	20.0	8.0	21.0	28.0	23.0	12.0	26.0	1.0	12.00
392	224000	160	1400	105	652	80.7	17.0	11.0	6.0	13.0	20.0	12.0	4.0	15.0	3.0	13.00
393	89948	78	1153	100	652	80.7	17.0	11.0	6.0	13.0	20.0	12.0	4.0	15.0	3.0	12.00
394	142975	133	1075	108	652	80.7	25.0	18.0	4.0	15.0	33.0	25.0	6.0	28.0	1.0	15.00
395	69997	68	1029	106	652	80.7	25.0	18.0	6.0	10.0	28.0	20.0	8.0	23.0	4.0	14.75
396	199980	81	2469	106	652	80.7	18.0	10.0	4.0	9.0	21.0	14.0	5.0	17.0	.5	14.75
397	99852	159	628	101	652	80.7	26.5	17.0	4.0	6.0	27.0	21.0	7.0	24.0	4.0	12.00
398	124960	160	781	104	652	80.7	30.0	23.0	6.0	8.0	31.0	24.0	6.0	27.0	5.5	12.50
399	136000	80	1700	105	652	80.7	16.0	11.0	4.0	2.0	17.0	11.0	6.0	14.0	4.0	13.00
400	149940	157	955	105	652	80.7	20.0	15.0	2.0	1.0	21.0	16.0	3.0	19.0	1.0	13.00
401	108958	78	1397	104	652	80.7	23.0	16.0	4.0	.5	24.0	17.0	4.0	20.0	3.0	12.50
402	115875	157	738	107	652	80.7	24.0	18.0	6.0	.5	25.0	19.0	6.0	22.0	5.0	15.00
403	58681	146	402	106	652	80.7	24.0	18.0	6.0	.5	25.0	19.0	6.0	22.0	5.0	14.75
404	89493	155	577	100	652	80.7	29.0	22.0	3.0	.5	30.0	23.0	3.0	26.0	2.0	12.00
405	29915	153	196	102	652	80.7	29.0	22.0	3.0	.5	30.0	23.0	3.0	26.0	2.0	12.00
406	229992	319	721	100	652	80.7	30.0	24.0	5.0	3.0	33.0	27.0	5.0	30.0	4.5	12.00
407	200000	160	1250	108	652	80.7	13.5	6.5	6.0	6.5	15.5	9.5	7.0	12.5	4.5	15.00
408	172000	160	1075	98	652	80.7	15.0	9.0	8.0	6.0	18.0	12.0	10.0	15.0	7.0	12.00

DATA LISTING (continued):

ID	SALE	SIZE	DOLLAR	TIME	POP	CPI	SCBD	SBRY	SAT	THWY	TCBD	TBRY	TSAT	TSC	SBDV	INTRT
409	60000	160	375	101	652	80.7	27.0	21.0	9.0	6.0	32.0	24.0	13.0	27.0	8.0	12.00
410	100000	160	625	100	652	80 7	28.5	22.0	10.0	3.5	32.0	25.0	12.0	28.0	5.0	12.00
411	20400	136	150	64	596	62.3	25.0	19.0	9.0	11.0	30.0	20.0	11.0	18.0	9.0	10.25
412	38500	160	241	62	596	62.3	25.0	13.0	5.0	10.5	31.0	19.0	9.0	20.0	5.0	9.75
413	20000	160	125	61	596	62.3	28.0	16.5	1.0	3.5	33.5	23.5	2.0	20.5	10.0	9.75
414	31000	80	388	67	596	62.3	28.0	16.5	1.5	4.5	34.5	24.5	3.0	21.5	10.0	10.25
415	16000	160	100	61	596	62.3	31.0	23.0	5.0	4.0	33.0	23.0	6.0	25.0	5.0	9.75
416	55000	160	344	71	596	62.3	30.5	22.5	4.0	3.0	32.0	22.0	5.0	24.0	4.0	9.75
417	60000	160	375	70	596	62.3	32.0	24.5	7.5	7.0	37.0	27.0	9.0	29.0	7.0	10.25
418	180000	160	1125	67	596	62.3	22.5	15.0	2.0	14.0	25.0	18.0	2.5	19.0	2.0	10.25
419	112000	160	700	61	596	62.3	21.0	14.0	2.5	1.0	23.0	16.0	3.0	18.0	1.5	9.75
420	35000	156	225	71	596	62.3	23.5	15.0	5.0	.0	24.5	15.5	5.0	17.0	3.0	9.75
421	82000	160	513	66	596	62.3	27.0	20.5	9.0	12.0	31.0	25.0	12.0	27.0	9.0	10.25
422	28000	100	281	61	596	62.5	24.5	18.0	9.0	10.0	30.0	23.0	10.0	25.0	9.0	9.75
423	35000	147	238	66	596	62.3	17.0	10.5	.5	.0	18.0	11.0	1.0	13.0	.0	10.25
424	35500	159	223	71	596	62.3	22.0	15.5	7.0	6.0	25.0	19.0	7.0	17.0	6.0	9.75
425	18000	80	225	66	596	62.3	26.0	12.0	11.0	22.0	33.0	19.0	14.0	21.0	2.5	10.25
426	80000	160	500	62	596	62.3	19.0	11.0	10.0	14.0	26.0	18.0	14.0	20.0	2.0	9.75
427	192000	160	1200	64	596	62.3	16.5	8.0	7.0	6.0	20.0	12.0	7.0	12.0	.0	10.25
428	51000	55	921	63	596	62.3	20.5	6.0	4.0	17.0	23.0	11.0	5.0	13.0	3.0	10.25
429	66000	109	603	62	596	62.3	18.5	5.0	3.0	11.0	22.0	6.0	3.5	12.0	.0	9.75
430	79500	159	500	64	596	62.3	15.0	3.0	5.0	9.0	17.0	5.0	5.0	5.5	1.0	10.25
431	300000	277	1084	72	596	62.3	17.0	6.5	6.0	9.0	22.0	6.0	8.0	15.0	.0	9.25
432	75000	162	463	69	596	62.3	12.0	.5	3.0	6.0	14.0	.5	5.0	6.5	.0	10.25
433	100000	101	990	71	596	62.3	16.0	5.5	9.5	10.0	22.0	5.5	13.0	14.0	.0	9.75
434	73000	157	464	64	596	62.3	18.0	8.0	4.0	5.0	23.0	8.0	4.5	9.5	.0	10.25
435	60000	160	375	61	596	62.3	19.0	7.0	4.0	11.5	26.5	11.5	5.5	17.5	2.0	9.75
436	98000	156	627	67	596	62.3	21.0	9.0	11.0	17.0	32.0	13.0	11.0	15.0	4.0	10.25
437	12500	80	156	61	596	62.3	17.0	6.0	2.0	1.0	18.0	7.0	3.0	8.0	.0	9.75
438	84500	157	539	67	596	62.3	25.0	13.0	14.0	13.0	32.0	17.0	15.0	27.0	5.0	10.25
439	78000	160	488	64	596	62.3	20.0	9.0	6.0	7.0	24.0	9.0	6.5	15.0	1.0	10.25
440	63000	151	416	71	596	62.3	20.5	9.0	2.0	3.0	20.0	10.0	3.0	12.0	1.0	9.75
441	90000	156	577	61	596	62.3	24.0	11.5	1.0	11.5	32.5	20.0	1.0	22.0	1.0	9.75
442	54000	160	338	64	596	62.3	32.0	20.0	13.0	3.5	35.0	23.0	14.5	25.0	10.0	10.25
443	36000	79	456	67	596	62.3	30.0	18.5	7.5	13.0	39.0	28.0	10.0	30.0	7.0	10.25
444	70016	160	438	70	596	62.3	30.0	18.0	16.0	19.0	35.0	23.0	20.0	25.0	16.0	10.25
445	75000	160	469	68	596	62.3	27.0	16.0	9.0	9.5	36.5	24.5	14.0	26.0	9.0	10.25
446	41600	160	260	66	596	62.3	22.5	12.0	7.0	8.0	27.0	13.0	11.0	14.0	1.5	10.25
447	155000	157	987	65	596	62.3	18.0	7.0	6.0	5.0	26.0	8.0	9.0	9.0	2.0	10.25
448	32000	86	370	71	596	62.3	23.5	11.0	3.0	16.0	23.0	11.0	3.0	14.0	.0	10.25
449	84467	160	528	67	596	62.3	21.0	16.0	15.0	2.0	23.0	18.0	17.0	18.0	.0	10.25
450	160000	159	1006	63	596	62.3	17.0	9.0	11.0	8.0	25.0	11.0	19.0	19.0	.0	10.25
451	105000	140	750	64	596	62.3	21.0	16.0	14.0	1.0	22.0	17.0	15.0	17.0	.0	10.25
452	46000	80	575	82	614	68.0	28.0	15.0	8.0	18.0	31.0	16.0	9.0	18.0	4.0	8.25
453	140000	160	875	80	614	68.0	27.0	20.0	2.0	3.0	30.0	23.0	3.0	25.0	2.0	8.25
454	80000	160	500	80	614	68.0	30.0	22.0	4.0	2.0	33.0	25.0	4.5	27.0	3.0	8.25
455	40000	160	250	84	614	68.0	31.0	24.0	9.0	7.0	36.0	28.0	9.0	29.5	8.0	8.25
456	45000	100	450	81	614	68.0	21.0	11.0	6.0	5.0	25.0	17.0	6.0	19.0	3.0	8.75
457	130000	160	813	83	614	68.0	22.0	10.0	2.0	10.0	25.0	18.0	3.0	18.0	1.0	8.25
458	35000	156	225	77	614	68.0	24.0	16.0	5.0	.0	25.0	17.0	5.0	19.0	3.5	8.75
459	58000	80	725	76	614	68.0	24.0	17.5	7.0	6.0	28.0	20.0	9.0	22.0	6.0	8.75

DATA LISTING (continued):

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 ID    SALE SIZE DOLLAR TIME POP   CPI  SCBD  SBRY   SAT  THWY  TCBD  TBRY  TSAT   TSC  SBDV  INTRT

460   97800   82  1200    74 614  68.0  16.0   3.0    .5  11.0  18.0   5.0    .5   7.0    .0   8.75
461   50000   78   641    79 614  68.0  16.0   4.5  10.0  10.0  17.0   5.0  13.0  10.0    .0   8.25
462   24000   80   300    84 614  68.0  17.5  10.0   3.0   3.0  21.0  15.0   4.0  18.0   2.0   8.25
463   95000  155   613    74 614  68.0  14.0   7.0   5.0    .0  14.0   7.0   5.0   9.0   3.0   8.75
464    9165   53   173    73 614  68.0  12.0   5.5   3.0   2.0  14.0   7.0   5.0   9.0   2.0   9.25
465   60000  160   375    83 614  68.0  19.0  11.0  12.0  11.0  22.0  15.0  12.0  17.0    .0   9.25
466   42000  163   258    83 614  68.0  16.0   7.0   4.0   6.0  20.0  12.0   9.0  13.0    .0   9.25
467  100000  147   679    83 614  68.0  15.0   3.5   1.5  11.0  23.0   4.0   2.0  15.0   1.0   9.25
468  200000  160  1250    84 614  68.0  18.0   8.0  11.0  11.0  26.0   7.0  13.0  19.0    .0   8.25
469  158000  143  1108    76 614  68.0  17.0   6.5   3.0   3.0  20.0   9.0   4.0  12.0    .0   8.75
470   75000   66  1136    81 614  68.0  20.0   8.5   7.0   8.0  28.0  16.5   8.0  18.0   5.0   8.25
471  160000  160  1000    78 614  68.0  17.0   6.0   5.0   6.0  21.0  10.0   7.0  12.0   4.0   8.25
472  165000  156  1055    77 614  68.0  19.0   7.0   2.5  11.0  25.0  15.0   6.0  17.0   2.0   8.25
473   70000  155   452    75 614  68.0  22.0  10.0  15.0  17.0  32.0  17.0  19.0  21.0   3.0   8.75
474  109000  109  1000    73 614  68.0  19.5   9.0   1.0   2.0  21.0  11.0   2.0  13.0    .0   9.25
475  110000  160   688    84 614  68.0  19.0   8.0   5.0   6.0  25.0   8.0   5.0  15.0    .0   8.25
476  105000  158   665    76 614  68.0  25.0  13.0   2.0  14.0  34.0  24.0   4.0  26.0   2.0   8.75
477   60000  160   375    78 614  68.0  26.0  15.0   8.0   5.0  31.0  20.0  11.0  22.0   5.0   8.25
478   25000  140   179    76 614  68.0  31.0  20.0  10.0   7.0  36.0  25.0  12.0  27.0   9.0   8.75
479   14000  160    88    77 614  68.0  30.5  19.0   7.5  11.0  39.0  28.0   9.0  30.0   7.0   8.75
480   25000   80   313    80 614  68.0  32.0  20.0   9.0  12.5  40.0  30.0  12.0  32.0   8.0   8.25
481   60000  160   375    84 614  68.0  30.0  19.0   8.0  10.0  36.0  27.0   9.0  29.0   7.0   8.25
482   50000   80   621    74 614  68.0  30.5  19.5  13.0  13.0  39.0  28.0  19.0  30.0  11.0   8.75
483   48000  160   300    77 614  68.0  24.0  12.0   7.0  13.0  28.0  13.0  11.0  15.0   3.0   8.25
484   25778   69   375    82 614  68.0  23.0  17.0  16.0    .0  23.0  17.0  16.0  17.0    .0   8.25
485  250000  320   781    79 614  68.0  23.0  17.0  14.0   3.0  26.0  20.0  17.0  21.0    .0   8.25
486  150000  157   955    77 614  68.0  19.0   9.0   7.0   6.0  25.0  15.0  11.0  17.0   1.0   8.75
487  174000  120  1450    80 614  68.0  15.0   2.0   1.5   6.0  17.0   3.0   2.0   6.0    .0   9.25
488   40000   80   500    81 614  68.0  13.0   1.5  11.0   6.0  14.0   1.5  14.0   8.0   1.0   8.25
489   27792  147   189    78 614  68.0  19.0  10.0  14.0  12.0  21.0  11.0  16.0  18.0    .0   8.25

NUMBER OF CASES READ =      489    NUMBER OF CASES LISTED =      489
```

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
1	1	0	0	1	1	2160	1	0	0	0	1	2	1	0	0	1	72	0	2.9	8818	102	144	130	2.85
2	2	0	0	1	0	0	0	0	0	0	1	2	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
3	3	1	0	0	0	1180	1	0	0	1	0	6	0	1	0	0	62	0	2.9	278	92	358	1630	2.85
4	9	0	0	1	0	0	0	0	0	0	1	6	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
5	1	0	0	1	1	861	1	1	0	0	0	6	0	0	0	1	65	0	2.9	23918	65	426	2490	2.85
6	3	0	0	1	0	226	0	0	1	0	0	2	0	0	0	1	72	0	2.9	28662	60	23	125	2.85
7	1	0	0	1	0	194	0	0	0	0	1	6	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
8	2	0	0	1	1	2253	1	0	0	0	1	2	1	1	0	0	72	0	2.9	8818	102	144	130	2.85
9	4	1	0	0	0	2844	1	0	0	1	0	6	0	1	0	0	62	0	2.9	278	92	358	1630	2.85
10	4	0	0	1	0	7	0	0	0	0	1	6	0	1	0	0	72	0	2.9	8818	102	144	100	2.85
11	2	1	0	0	1	9999	1	0	0	1	0	2	1	1	0	0	62	0	2.9	278	92	358	1630	2.85
12	1	0	0	1	1	66	0	1	0	0	0	4	1	0	0	1	65	0	2.9	23918	65	426	2490	2.85
13	6	0	0	1	0	261	0	0	1	0	0	5	0	1	0	0	72	0	2.9	28662	60	23	125	2.85
14	3	0	0	1	0	194	0	0	0	0	1	3	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
15	3	0	0	1	0	408	1	0	0	0	1	2	1	0	0	1	72	0	2.9	8818	102	144	130	2.85
16	4	0	0	1	1	319	0	0	1	0	0	2	1	1	0	0	72	0	2.9	28662	60	23	125	2.85
17	1	0	0	1	1	226	0	0	1	0	0	2	0	0	0	1	72	0	2.9	28662	60	23	125	2.85
18	2	0	0	1	0	797	1	1	0	0	0	6	0	0	0	1	65	0	2.9	23918	65	426	2490	2.85
19	3	0	0	1	1	2562	1	1	0	0	0	2	0	1	0	0	65	0	2.9	23918	65	426	2490	2.85
20	1	0	0	1	0	408	1	0	0	0	1	6	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
21	3	0	0	1	1	408	0	0	0	0	1	2	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
22	1	0	1	0	1	298	1	0	1	0	0	1	0	0	1	0	72	1	2.9	28662	60	23	125	2.85
23	2	0	0	1	0	342	0	0	0	0	1	3	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
24	5	1	0	0	0	92	0	1	0	0	0	6	0	1	0	0	65	0	2.9	23918	65	426	2490	2.85
25	1	0	0	1	0	256	0	0	0	0	1	6	0	0	0	1	62	0	2.9	278	92	358	1630	2.85
26	3	0	0	1	0	651	1	0	0	1	0	6	0	1	0	0	62	0	2.9	278	92	358	1630	2.85
27	1	0	0	1	1	2562	1	1	0	0	0	2	0	1	0	0	65	0	2.9	23918	65	426	2490	2.85
28	4	0	0	1	1	756	1	0	1	0	0	6	1	1	0	0	72	1	2.9	28662	60	23	125	2.85
29	3	1	0	0	0	815	1	1	0	0	0	3	0	1	0	0	65	0	2.9	23918	65	426	2490	2.85
30	2	1	0	0	1	9999	1	0	0	1	0	2	1	1	0	0	62	0	2.9	278	92	358	1630	2.85
31	3	1	0	0	1	9999	1	0	0	1	0	2	1	1	0	0	62	0	2.9	278	92	358	1630	2.85
32	1	0	0	1	1	782	0	0	0	1	0	6	1	1	0	0	62	0	2.9	278	92	358	1630	2.85
33	2	0	0	1	1	408	0	0	0	0	1	6	1	0	0	1	72	0	2.9	8818	102	144	100	2.85
34	2	0	0	1	1	92	1	0	0	0	1	2	1	1	0	0	72	0	2.9	8818	102	144	100	2.85
35	5	0	0	1	0	280	0	0	0	0	1	6	0	0	0	1	72	0	2.9	8818	102	144	130	2.85
36	3	0	0	1	0	732	1	0	1	0	0	5	0	1	0	0	72	0	2.9	28662	60	23	125	2.85
37	2	0	0	1	1	469	0	0	0	1	0	2	0	0	0	1	62	0	2.9	278	92	358	1630	2.85
38	1	0	0	1	0	297	0	0	0	0	1	6	0	0	0	1	62	0	2.9	278	92	358	1630	2.85
39	1	0	0	1	0	399	0	0	1	0	0	6	0	0	0	1	72	0	2.9	28662	60	23	125	2.85
40	1	0	0	1	0	1419	1	0	0	1	0	2	0	1	0	0	62	0	2.9	278	92	358	1630	2.85
41	3	0	0	1	1	2562	0	1	0	0	0	6	0	0	0	1	65	0	2.9	23918	65	426	2490	2.85
42	2	0	0	1	0	797	1	1	0	0	0	6	0	0	0	1	65	0	2.9	23918	65	426	2490	2.85
43	4	1	0	0	0	1180	1	0	0	1	0	5	0	1	0	0	62	0	2.9	278	92	358	1630	2.85
44	1	0	0	1	0	250	0	0	0	0	1	6	0	0	0	1	72	0	2.9	8818	102	144	100	2.85
45	5	1	0	0	0	1400	1	0	0	1	0	6	0	1	0	0	62	0	2.9	278	92	358	1630	2.85
46	1	0	0	1	0	399	0	0	1	0	0	6	0	0	0	1	72	0	2.9	28662	60	23	125	2.85
47	3	0	0	1	0	194	0	0	0	0	1	3	0	0	0	1	72	0	2.9	8818	102	144	100	2.85
48	1	0	0	1	0	399	0	0	1	0	0	2	0	0	0	1	72	0	2.9	28662	60	23	125	2.85
49	1	0	0	1	1	326	0	1	0	0	0	6	0	0	0	1	65	0	2.9	23918	65	426	2490	2.85
50	1	0	0	1	1	376	0	1	0	0	0	6	0	0	0	1	65	0	2.9	23918	65	426	2490	2.85
51	5	0	0	1	0	326	0	1	0	0	0	6	0	0	0	1	65	0	2.9	23918	65	426	2490	2.85

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
52	0	0	0	1	1	889	0	0	0	1	0	6	1	1	0	0	65	0	2.9	887	350	169	920	2.86
53	1	0	0	1	1	226	1	0	1	0	0	2	0	0	0	1	75	0	2.9	39260	69	55	640	2.86
54	5	1	0	0	0	2844	1	0	0	1	0	6	0	1	0	0	65	0	2.9	887	350	169	920	2.86
55	4	0	0	1	1	540	1	1	0	0	0	6	1	0	0	1	64	1	2.9	29072	68	158	785	2.86
56	1	0	0	1	1	715	0	0	0	1	0	6	0	0	0	1	65	1	2.9	887	350	169	920	2.86
57	0	0	0	1	0	399	0	0	1	0	0	2	0	0	0	1	75	0	2.9	39260	69	55	640	2.86
58	2	0	0	1	0	430	0	0	0	0	1	2	0	0	0	1	75	0	2.9	5130	105	58	320	2.86
59	3	0	0	1	0	242	0	0	1	0	0	6	0	0	0	1	75	0	2.9	39260	69	55	640	2.86
60	3	1	0	0	0	797	0	1	0	0	0	5	0	0	0	1	64	0	2.9	29072	68	158	785	2.86
61	1	1	0	0	1	9999	0	0	0	1	0	2	1	1	0	0	65	0	2.9	887	350	169	920	2.86
62	5	0	0	1	0	400	0	0	0	1	0	6	0	0	0	1	65	0	2.9	887	350	169	920	2.86
63	9	1	0	0	0	0	0	0	0	0	1	6	0	1	0	0	75	0	2.9	5130	105	58	320	2.86
64	1	0	0	1	0	297	0	0	0	0	1	6	0	0	0	1	75	0	2.9	5030	105	58	320	2.86
65	3	0	0	1	0	345	0	0	0	0	1	6	0	0	0	1	75	0	2.9	5130	105	58	320	2.86
66	1	0	0	1	1	756	1	0	1	0	0	6	0	0	0	1	75	0	2.9	39260	69	55	640	2.86
67	3	0	0	1	0	410	0	0	1	0	0	6	0	1	0	0	75	0	2.9	39260	69	55	640	2.86
68	2	0	0	1	0	518	1	0	0	0	1	6	0	0	0	1	75	0	2.9	5130	105	58	320	2.86
69	9	0	0	1	0	0	0	0	0	0	1	6	0	1	0	0	75	0	2.9	5130	105	58	320	2.86
70	3	0	0	1	0	280	0	0	0	0	1	6	0	1	0	0	75	0	2.9	5130	105	58	320	2.86
71	1	0	1	0	1	715	1	0	0	0	1	2	1	0	1	0	75	0	2.9	5130	105	58	320	2.86
72	1	0	0	1	0	651	0	0	0	1	0	6	0	0	0	1	65	0	2.9	887	350	169	920	2.86
73	4	0	0	1	0	319	0	0	1	0	0	6	0	1	0	0	75	0	2.9	39260	69	55	640	2.86
74	5	0	0	1	1	889	1	0	0	1	0	6	0	0	0	1	65	0	2.9	887	350	169	920	2.86
75	6	1	0	0	0	685	1	0	0	0	1	6	0	1	0	0	75	0	2.9	5130	105	58	320	2.86
76	3	0	0	1	0	250	0	0	0	0	1	5	0	0	0	1	75	0	2.9	5130	105	58	320	2.86
77	3	0	0	1	1	756	0	0	1	0	0	6	0	0	0	1	75	0	2.9	39260	69	55	640	2.86
78	1	0	0	1	0	319	0	0	1	0	0	6	0	1	0	0	75	0	2.9	39260	69	55	640	2.86
79	2	0	0	1	1	2160	1	0	0	1	0	2	1	0	0	1	65	0	2.9	887	350	169	920	2.86
80	2	0	0	1	1	386	1	0	0	0	1	5	0	0	0	1	75	0	2.9	5130	105	58	320	2.86
81	3	1	0	0	1	9999	1	0	0	1	0	6	0	1	0	0	65	0	2.9	887	350	169	920	2.86
82	1	0	0	1	0	386	1	0	0	0	1	6	0	0	0	1	75	0	2.9	5130	105	58	320	2.86
83	1	0	0	1	0	430	1	0	0	0	1	6	0	0	0	1	75	0	2.9	5130	105	58	320	2.86
84	3	0	0	1	0	797	1	1	0	0	0	6	0	1	0	0	64	0	2.9	29072	68	158	785	2.86
85	1	0	0	1	1	298	0	0	1	0	0	5	0	0	0	1	75	0	2.9	39260	69	55	640	2.86
86	3	0	0	1	1	889	1	0	0	1	0	6	1	1	0	0	65	0	2.9	887	350	169	920	2.86
87	9	0	0	1	0	2844	1	0	0	1	0	6	0	1	0	0	65	0	2.9	887	350	169	920	2.86
88	2	0	0	1	1	685	0	0	0	0	1	6	1	0	0	1	75	0	2.9	5130	105	58	320	2.86
89	3	0	0	1	0	377	0	0	0	0	1	6	0	1	0	0	75	0	2.9	5130	105	58	320	2.86
90	4	0	0	1	0	32	0	0	1	0	0	6	0	0	0	1	75	1	2.9	39260	69	55	640	2.86
91	6	0	0	1	0	797	1	1	0	0	0	6	0	1	0	0	64	0	3.1	51361	207	399	2183	3.48
92	1	0	0	1	0	94	0	0	1	0	0	2	0	0	0	1	75	0	3.1	67567	146	8	50	3.48
93	4	1	0	0	0	1180	1	0	0	1	0	5	1	1	0	0	68	0	3.1	22603	475	218	1100	3.48
94	1	0	0	1	1	756	1	0	1	0	0	6	0	0	0	1	75	0	3.1	67567	146	8	50	3.48
95	1	0	0	1	1	861	1	1	0	0	0	2	1	0	0	1	64	0	3.1	51361	207	399	2183	3.48
96	1	0	0	1	0	194	1	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
97	5	0	0	1	0	73	0	0	1	0	0	6	0	0	0	1	75	1	3.1	67567	146	8	50	3.48
98	1	0	0	1	1	756	1	0	1	0	0	5	1	0	0	1	75	0	3.1	67567	146	8	50	3.48
99	1	0	0	1	0	250	0	0	0	0	1	5	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
100	4	1	0	0	0	1400	1	0	0	1	0	2	0	1	0	0	68	0	3.1	22603	475	218	1100	3.48
101	1	0	1	0	1	715	0	0	0	1	0	2	1	0	1	0	68	0	3.1	22603	475	218	1100	3 48
102	4	0	0	1	0	518	1	0	0	0	1	6	0	1	0	0	78	0	3.1	36171	284	685	300	3.48

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
103	1	0	0	1	0	685	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
104	1	0	0	1	0	297	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
105	1	0	0	1	0	410	0	0	1	0	0	6	0	1	0	0	75	0	3.1	67567	146	8	50	3.48
106	4	0	0	1	1	319	1	0	1	0	0	6	1	1	0	0	75	1	3.1	67567	146	8	50	3.48
107	3	0	0	1	0	408	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
108	6	0	0	1	0	280	0	0	0	0	1	6	0	1	0	0	78	0	3.1	36171	284	685	300	3.48
109	1	0	0	1	0	756	0	0	1	0	0	6	0	0	0	1	75	0	3.1	67567	146	8	50	3.48
110	1	0	0	1	1	496	0	0	0	1	0	5	0	0	0	1	68	0	3.1	22603	475	218	1100	3.48
111	1	0	0	1	0	359	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
112	1	0	0	1	0	430	1	0	0	0	1	2	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
113	3	0	0	1	0	377	0	0	0	0	1	3	0	1	0	0	78	0	3.1	36171	284	685	300	3.48
114	3	0	0	1	0	476	1	0	1	0	0	6	0	0	0	1	75	0	3.1	67567	146	8	50	3.48
115	4	0	0	1	0	261	0	0	1	0	0	5	0	0	0	1	75	0	3.1	67567	146	8	50	3.48
116	3	0	0	1	0	194	0	0	0	0	1	6	0	0	0	1	78	1	3.1	36171	284	685	300	3.48
117	2	0	0	1	0	476	0	0	1	0	0	6	0	1	0	0	75	0	3.1	67567	146	8	50	3 48
118	3	0	0	1	0	250	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
119	2	1	0	0	1	715	1	0	0	1	0	2	0	1	0	0	68	0	3.1	22603	475	218	1100	3.48
120	3	0	0	1	0	476	0	0	1	0	0	2	0	1	0	0	75	0	3.1	67567	146	8	50	3.48
121	2	0	0	1	0	282	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
122	1	0	0	1	0	250	0	0	0	0	1	5	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
123	3	1	0	0	0	377	1	0	0	0	1	6	0	1	0	0	78	0	3.1	36171	284	685	300	3.48
124	3	0	0	1	1	2160	1	0	0	1	0	2	1	0	0	1	68	0	3.1	22603	475	218	1100	3.48
125	3	0	0	1	0	345	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
126	6	0	0	1	1	2160	0	0	0	0	1	2	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
127	1	0	0	1	0	399	0	0	1	0	0	6	0	0	0	1	75	0	3.1	67567	146	8	50	3.48
128	4	0	0	1	0	342	0	0	0	0	1	5	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
129	6	1	0	0	1	1939	1	1	0	0	0	2	0	1	0	0	64	0	3.1	51361	207	399	2183	3.48
130	3	0	0	1	0	408	0	0	0	0	1	6	0	0	0	1	78	0	3.1	36171	284	685	300	3.48
131	2	0	0	1	1	861	0	1	0	0	0	3	0	0	0	1	64	0	3.1	51361	207	399	2183	3.48
132	2	0	0	1	0	330	0	0	1	0	0	6	0	0	0	1	75	0	3.1	67567	146	8	50	3.48
133	1	1	0	0	0	518	1	0	0	0	1	6	0	1	0	0	78	0	3.1	36171	284	685	300	3.48
134	1	0	0	1	1	319	1	0	1	0	0	2	0	0	0	1	75	1	1.9	71629	202	63	250	5.83
135	1	0	0	1	0	815	0	1	0	0	0	6	0	0	0	1	79	0	1.9	51494	309	320	1700	5.83
136	1	1	0	0	1	1939	1	1	0	0	0	6	0	1	0	0	79	0	1.9	51494	309	320	1700	5.83
137	5	1	0	0	0	32	0	0	1	0	0	6	0	1	0	0	75	1	1.9	71629	202	63	250	5.83
138	6	0	0	1	1	756	0	0	1	0	0	5	1	0	0	1	75	0	1.9	71629	202	63	250	5.83
139	2	0	0	1	0	261	0	0	1	0	0	5	0	1	0	0	75	0	1.9	71629	202	63	250	5.83
140	2	0	0	1	1	756	1	0	1	0	0	5	0	0	0	1	75	0	1.9	71629	202	63	250	5.83
141	1	0	0	1	0	261	0	0	1	0	0	5	0	1	0	0	75	0	1.9	71629	202	63	250	5.83
142	2	0	0	1	0	1419	0	0	0	1	0	6	0	0	0	1	64	0	1.9	31289	863	140	1100	5.83
143	4	0	0	1	0	92	0	0	0	0	1	3	0	1	0	0	99	1	1.9	49540	401	109	730	5.83
144	2	0	0	1	0	194	1	0	0	0	1	5	0	1	0	0	99	0	1.9	49540	401	109	730	5.83
145	2	1	0	0	1	2253	1	0	0	0	1	2	1	1	0	0	99	0	1.9	49540	401	109	730	5.83
146	1	0	0	1	0	430	0	0	0	0	1	2	0	0	0	1	99	0	1.9	49540	401	109	730	5.83
147	3	0	0	1	0	0	0	0	0	0	1	5	0	1	0	0	99	0	1.9	49540	401	109	730	5.83
148	4	1	0	0	0	732	1	0	1	0	0	2	0	1	0	0	75	0	1.9	71629	202	63	250	5.83
149	1	0	0	1	0	226	0	0	1	0	0	6	0	0	0	1	75	0	1.9	71629	202	63	250	5.83
150	5	1	0	0	0	1180	1	0	0	1	0	6	0	1	0	0	64	0	1.9	31289	863	140	1100	5.83
151	3	0	0	1	0	476	0	0	1	0	0	6	0	1	0	0	75	0	1.9	71629	202	63	250	5.83
152	3	0	0	1	1	9999	1	0	0	0	1	2	1	0	0	1	99	0	1.9	49540	401	109	730	5.83
153	3	0	0	1	0	476	0	0	1	0	0	6	0	1	0	0	75	0	1.9	71629	202	63	250	5.83

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
154	1	0	0	1	0	496	0	0	0	1	0	6	0	0	0	1	64	0	1.9	31289	863	140	1100	5.83
155	6	0	0	1	0	176	0	0	0	1	0	6	0	1	0	0	64	0	1.9	31289	863	140	1100	5.83
156	1	0	0	1	0	651	0	0	0	1	0	5	0	0	0	1	64	0	1.9	31289	863	140	1100	5.83
157	5	1	0	0	0	280	0	0	0	0	1	2	0	1	0	0	99	0	1.9	49540	401	109	730	5.83
158	1	1	0	0	0	280	0	0	0	0	1	6	0	1	0	0	99	0	1.9	49540	401	109	730	5.83
159	6	0	0	1	0	176	0	0	0	1	0	6	0	0	1	0	64	0	1.9	31289	863	140	1100	5.83
160	2	1	0	0	0	261	1	0	1	0	0	5	0	1	0	0	75	0	1.9	71629	202	63	250	5.83
161	1	0	0	1	0	518	1	0	0	0	1	6	0	0	0	1	99	0	1.9	49540	401	109	730	5.83
162	4	0	0	1	0	32	0	0	1	0	0	6	0	1	0	0	75	0	1.9	71629	202	63	250	5.83
163	1	0	0	1	1	651	0	0	0	1	0	5	0	0	0	1	64	0	1.9	31289	863	140	1100	5.83
164	6	0	0	1	1	756	1	0	1	0	0	5	1	0	0	1	75	0	1.9	71629	202	63	250	5.83
165	1	0	0	1	0	303	0	0	1	0	0	5	0	0	0	1	75	0	1.9	71629	202	63	250	5.83
166	3	0	0	1	0	345	0	0	0	0	1	6	0	0	0	1	99	0	1.9	49540	401	109	730	5.83
167	3	0	0	1	0	330	0	0	1	0	0	6	0	0	0	1	75	0	1.9	71629	202	63	250	5.83
168	1	0	0	1	0	303	0	0	1	0	0	6	0	0	0	1	75	0	1.9	71629	202	63	250	5.83
169	1	0	0	1	0	297	1	0	0	0	1	2	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
170	1	0	0	1	0	256	0	0	0	0	1	6	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
171	1	0	0	1	1	1419	0	0	0	1	0	6	0	0	0	1	64	0	2.6	28304	767	699	3730	7.25
172	1	0	0	1	0	651	0	0	0	1	0	6	0	0	0	1	64	0	2.6	28304	767	699	3730	7.25
173	1	0	0	1	0	419	0	0	1	0	0	6	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
174	1	0	0	1	0	0	0	0	0	0	1	2	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
175	1	0	0	1	0	399	0	0	1	0	0	5	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
176	1	0	0	1	0	386	0	0	0	1	0	6	0	0	0	1	64	0	2.6	28304	767	699	3730	7.25
177	2	0	0	1	0	496	0	0	0	1	0	6	0	0	0	1	64	0	2.6	28304	767	699	3730	7.25
178	1	0	0	1	0	535	0	0	0	0	1	3	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
179	1	0	0	1	0	359	0	0	0	0	1	6	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
180	2	0	0	1	0	7	0	0	0	0	1	6	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
181	2	0	0	1	0	60	0	1	0	0	0	6	0	0	0	1	87	0	2.6	45751	389	226	1325	7.25
182	4	1	0	0	0	2844	1	0	0	1	0	6	0	1	0	0	64	0	2.6	28304	767	699	3730	7.25
183	3	0	0	1	0	32	0	0	0	0	1	6	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
184	1	0	0	1	0	535	0	0	0	0	1	6	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
185	3	0	0	1	0	194	0	0	0	0	1	6	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
186	2	0	0	1	1	469	0	0	0	1	0	6	0	0	0	1	64	0	2.6	28304	767	699	3730	7.25
187	3	0	0	1	0	342	0	0	0	0	1	6	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
188	2	0	0	1	0	2562	0	0	0	0	1	5	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
189	3	0	0	1	0	242	0	0	1	0	0	6	0	1	0	0	80	0	2.6	64435	309	65	370	7.25
190	4	0	0	1	1	298	1	0	1	0	0	6	1	0	1	0	80	0	2.6	64435	309	65	370	7.25
191	2	0	0	1	0	476	0	0	1	0	0	6	0	1	0	0	80	0	2.6	64435	309	65	370	7.25
192	1	0	0	1	0	298	0	0	0	0	1	6	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
193	2	0	0	1	0	242	0	0	1	0	0	6	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
194	3	0	0	1	0	342	0	0	0	0	1	3	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
195	3	0	0	1	0	342	0	0	0	0	1	6	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
196	1	0	0	1	0	256	0	0	0	0	1	5	0	0	0	1	80	0	2.6	64435	309	65	370	7.25
197	2	0	0	1	0	797	1	1	0	0	0	6	0	0	0	1	87	0	2.6	45751	389	226	1325	7.25
198	2	0	0	1	0	7	0	0	0	0	1	2	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
199	2	0	0	1	0	7	0	0	0	0	1	2	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
200	1	0	0	1	0	685	0	0	0	0	1	2	0	0	0	1	98	0	2.6	45233	496	58	280	7.25
201	4	0	0	1	0	1400	0	0	0	1	0	2	0	1	0	0	64	0	2.6	28304	767	699	3730	7.25
202	4	0	0	1	0	889	1	0	0	1	0	2	0	1	0	0	64	0	2.6	28304	767	699	3730	7.25
203	2	0	0	1	0	286	0	0	1	0	0	6	0	0	0	1	64	0	2.6	28304	767	699	3730	7.25
204	2	0	0	1	0	297	0	0	0	0	1	2	0	0	0	1	98	0	2.6	45233	496	58	280	7.25

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
205	3	1	0	0	0	2529	1	0	0	1	0	6	0	1	0	0	94	0	3.1	14963	579	411	2150	12.25
206	3	1	0	0	0	1574	1	0	0	1	0	6	0	1	0	0	94	0	3.1	14963	579	411	2150	12.25
207	1	0	0	1	0	848	0	0	0	1	0	6	0	0	0	1	94	0	3.1	14963	579	411	2150	12.25
208	1	0	0	1	0	848	0	0	0	1	0	5	0	0	0	1	94	0	3.1	14963	579	411	2151	12.25
209	1	0	0	1	0	484	0	0	0	1	0	6	0	0	0	1	94	0	3.1	14963	579	411	2150	12.25
210	4	1	0	0	0	4370	1	0	0	1	0	5	0	1	0	0	94	0	3.1	14963	579	411	2150	12.25
211	1	0	0	1	0	416	0	0	0	1	0	6	0	0	0	1	94	0	3.1	14963	579	411	2150	12.25
212	3	0	0	1	0	24	0	0	1	0	0	6	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
213	2	0	0	1	0	24	0	0	1	0	0	5	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
214	3	0	0	1	0	251	0	0	1	0	0	5	0	1	0	0	110	0	3.1	59336	402	34	245	12.25
215	2	0	0	1	0	722	1	0	1	0	0	6	0	1	0	0	110	0	3.1	59336	402	34	245	12.25
216	2	0	0	1	0	313	0	0	1	0	0	6	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
217	3	0	0	1	0	392	0	0	1	0	0	6	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
218	2	0	0	1	0	409	0	0	1	0	0	3	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
219	4	0	0	1	1	409	1	0	1	0	0	2	1	1	0	0	110	1	3.1	59336	402	34	245	12.25
220	4	0	0	1	1	1041	1	0	1	0	0	2	1	0	1	0	110	1	3.1	59336	402	34	245	12.25
221	4	0	0	1	0	480	0	0	1	0	0	6	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
222	4	0	0	1	0	312	0	0	1	0	0	6	0	1	0	0	110	0	3.1	59336	402	34	245	12.25
223	1	0	0	1	1	312	0	0	1	0	0	1	0	1	0	0	110	0	3.1	59336	402	34	245	12.25
224	4	0	0	1	0	380	0	0	1	0	0	6	0	1	0	0	110	0	3.1	59336	402	34	245	12.25
225	9	0	0	1	0	231	0	0	1	0	0	6	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
226	3	0	0	1	0	385	0	0	1	0	0	6	0	0	0	1	110	1	3.1	59336	402	34	245	12.25
227	1	0	0	1	0	287	0	0	1	0	0	6	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
228	1	0	0	1	0	287	0	0	1	0	0	6	0	0	0	1	110	0	3.1	59336	402	34	245	12.25
229	3	0	0	1	0	69	0	0	1	0	0	6	0	0	0	1	110	1	3.1	59336	402	34	245	12.25
230	1	0	0	1	1	398	1	1	0	0	0	5	1	1	0	0	103	0	3.1	40379	388	499	2650	12.25
231	3	0	0	1	0	1059	0	1	0	0	0	6	0	1	0	0	103	0	3.1	40379	388	499	2650	12.25
232	2	0	0	1	1	2692	1	1	0	0	0	2	1	0	0	1	103	0	3.1	40379	388	499	2650	12.25
233	6	1	0	0	0	219	0	0	0	0	1	2	0	1	0	0	89	1	3.1	36467	556	214	1148	12.25
234	6	1	0	0	0	419	0	0	0	0	1	6	0	1	0	0	89	0	3.1	36467	556	214	1148	12.25
235	2	0	0	1	0	717	1	0	0	0	1	6	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
236	2	0	0	1	1	717	1	0	0	0	1	2	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
237	2	0	0	1	0	717	1	0	0	0	1	2	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
238	1	0	0	1	0	483	0	0	0	0	1	6	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
239	1	0	0	1	0	1041	0	0	0	0	1	2	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
240	1	0	0	1	0	278	0	0	0	0	1	5	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
241	3	0	0	1	0	278	0	0	0	0	1	5	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
242	1	0	0	1	0	278	0	0	0	0	1	6	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
243	1	0	0	1	0	896	0	0	0	0	1	3	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
244	1	0	0	1	0	896	0	0	0	0	1	6	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
245	1	0	0	1	1	707	1	0	0	0	1	5	1	0	0	1	89	0	3.1	36467	556	214	1148	12.25
246	3	0	0	1	0	707	0	0	0	0	1	3	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
247	3	0	0	1	0	491	0	0	0	0	1	3	0	0	0	1	89	0	3.1	36467	556	214	1148	12.25
248	2	0	0	1	0	304	0	0	0	0	1	3	0	0	0	1	89	1	3.1	36467	556	214	1148	12.25
249	2	0	0	1	0	109	0	0	0	0	1	6	0	1	0	0	89	0	3.1	36467	556	214	1148	12.25
250	2	0	0	1	0	1574	1	0	0	1	0	6	0	0	0	1	82	0	3.0	12150	751	279	1430	15.58
251	2	0	0	1	0	1740	1	0	0	1	0	2	0	1	0	0	82	0	3.0	12150	751	279	1430	15.58
252	2	0	0	1	1	1740	0	0	0	1	0	6	0	0	0	1	82	0	3.0	12150	751	279	1430	15.58
253	2	0	0	1	1	416	1	0	0	1	0	6	1	0	0	1	82	0	3.0	12150	751	279	1430	15.58
254	3	0	0	1	0	1260	1	0	0	1	0	2	0	1	0	0	82	0	3.0	12150	751	279	1430	15.58
255	4	1	0	0	1	9999	1	0	0	1	0	6	0	1	0	0	82	0	3.0	12150	751	279	1430	15.58

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
256	1	0	0	1	1	563	0	0	0	1	0	6	1	0	1	0	82	0	3.0	12150	751	279	1430	15.58
257	1	0	0	1	1	563	0	0	0	1	0	6	1	0	0	1	82	0	3.0	12150	751	279	1430	15.58
258	1	0	0	1	1	843	0	0	0	1	0	6	1	1	0	0	82	0	3.0	12150	751	279	1430	15.58
259	1	0	0	1	0	313	0	0	1	0	0	6	0	1	0	0	132	0	3.0	40934	530	132	780	15.58
260	2	0	0	1	0	528	0	0	1	0	0	6	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
261	3	0	0	1	0	528	0	0	1	0	0	6	0	1	0	0	132	0	3.0	40934	530	132	780	15.58
262	3	0	0	1	0	987	0	0	1	0	0	6	0	1	0	0	132	0	3.0	40934	530	132	780	15.58
263	1	0	0	1	0	392	0	0	1	0	0	5	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
264	2	0	0	1	1	409	1	0	1	0	0	5	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
265	2	0	0	1	0	480	0	0	1	0	0	2	0	1	0	0	132	0	3.0	40934	530	132	780	15.58
266	1	0	0	1	1	277	0	0	1	0	0	6	0	0	0	1	132	1	3.0	40934	530	132	780	15.58
267	3	0	0	1	0	380	0	0	1	0	0	6	0	1	0	0	132	0	3.0	40934	530	132	780	15.58
268	1	0	0	1	0	380	0	0	1	0	0	6	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
269	4	0	0	1	0	380	0	0	1	0	0	6	0	1	0	0	132	0	3.0	40934	530	132	780	15.58
270	2	0	0	1	0	318	0	0	1	0	0	6	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
271	1	0	0	1	0	231	0	0	1	0	0	6	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
272	1	0	0	1	0	431	0	0	1	0	0	6	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
273	1	0	0	1	0	287	0	0	1	0	0	6	0	0	0	1	132	0	3.0	40934	530	132	780	15.58
274	2	0	0	1	0	1402	1	1	0	0	0	3	0	0	0	1	124	0	3.0	37728	452	355	1550	15.58
275	6	0	0	1	1	356	1	1	0	0	0	6	1	1	0	0	124	0	3.0	37728	452	355	1550	15.58
276	1	0	0	1	0	419	0	0	0	0	1	3	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
277	2	0	0	1	0	373	0	0	0	0	1	2	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
278	3	0	0	1	1	717	0	0	0	0	1	6	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
279	2	0	0	1	1	717	0	0	0	0	1	6	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
280	1	0	0	1	0	619	1	0	0	0	1	2	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
281	4	0	0	1	0	619	1	0	0	0	1	2	0	1	0	0	106	0	3.0	31525	537	323	955	15.58
282	5	1	0	0	0	619	1	0	0	0	1	6	0	1	0	0	106	0	3.0	31525	537	323	955	15.58
283	5	0	0	1	0	309	0	0	0	0	1	6	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
284	1	0	0	1	0	311	0	0	0	0	1	2	0	0	0	1	106	0	3.0	35525	537	323	955	15.58
285	1	0	0	1	0	707	0	0	0	0	1	3	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
286	3	0	0	1	0	491	0	0	0	0	1	6	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
287	3	0	0	1	0	275	0	0	0	0	1	3	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
288	3	0	0	1	0	275	0	0	0	0	1	5	0	0	0	1	106	0	3.0	31525	537	323	955	15.58
289	4	1	0	0	0	1308	1	0	0	0	1	6	0	1	0	0	106	0	3.0	31525	537	323	955	15.58
290	5	1	0	0	0	396	1	0	0	1	0	6	0	1	0	0	100	0	3.9	7164	782	248	1120	18.87
291	5	1	0	0	0	2529	1	0	0	1	0	6	0	1	0	0	100	0	3.9	7164	782	248	1120	18.87
292	4	0	0	1	0	219	0	0	0	1	0	6	0	0	1	0	100	0	3.9	7164	782	248	1120	18.87
293	3	0	0	1	0	1901	0	0	0	1	0	2	0	1	0	0	100	0	3.9	7164	782	248	1120	18.87
294	2	0	0	1	1	416	1	0	0	1	0	5	1	0	0	1	100	0	3.9	7164	782	248	1120	18.87
295	3	0	0	1	1	1260	0	0	0	1	0	6	0	0	0	1	100	0	3.9	7164	782	248	1120	18.87
296	2	0	0	1	0	313	0	0	1	0	0	6	0	0	0	1	156	0	3.9	43856	543	36	195	18.87
297	4	0	0	1	0	528	0	0	1	0	0	6	0	1	0	0	156	0	3.9	43856	543	36	195	18.87
298	4	0	0	1	0	987	1	0	1	0	0	2	0	1	0	0	156	0	3.9	43856	543	36	195	18.87
299	1	0	0	1	0	392	0	0	1	0	0	6	0	0	0	1	156	0	3.9	43856	543	36	195	18.87
300	1	0	0	1	0	392	0	0	1	0	0	6	0	0	0	1	156	0	3.9	43856	543	36	195	18.87
301	1	0	0	1	1	312	0	0	1	0	0	2	0	1	0	0	156	0	3.9	43856	543	36	195	18.87
302	2	0	0	1	0	385	0	0	1	0	0	3	0	0	0	1	156	1	3.9	43856	543	36	195	18.87
303	1	0	0	1	0	431	0	0	1	0	0	6	0	0	0	1	156	0	3.9	43856	543	36	195	18.87
304	1	0	0	1	0	287	0	0	1	0	0	6	0	0	0	1	156	0	3.9	43856	543	36	195	18.87
305	1	0	0	1	1	1041	0	0	1	0	0	6	0	0	0	1	156	0	3.9	43856	543	36	195	18.87
306	2	0	0	1	0	398	1	1	0	0	0	6	0	1	0	0	136	0	3.9	34020	493	161	725	18.87

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
307	2	0	0	1	0	1402	0	1	0	0	0	3	0	0	0	1	136	0	3.9	34020	493	161	725	18.87
308	3	0	0	1	0	1308	1	1	0	0	0	5	0	1	0	0	136	0	3.9	34020	493	161	725	18.87
309	1	0	0	1	1	65	0	1	0	0	0	2	1	0	0	1	136	0	3.9	34020	493	161	725	18.87
310	2	0	0	1	0	419	0	0	0	0	1	3	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
311	6	0	0	1	0	373	0	0	0	0	1	3	0	1	0	0	112	0	3.9	23983	671	165	750	18.87
312	3	0	0	1	0	373	0	0	0	0	0	6	0	1	0	0	112	0	3.9	23983	671	165	750	18.87
313	4	0	0	1	0	373	0	0	0	0	1	6	0	1	0	0	112	0	3.9	23983	671	165	750	18.87
314	2	0	0	1	0	373	0	0	0	0	1	2	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
315	2	0	0	1	0	373	0	0	0	0	1	2	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
316	1	0	0	1	0	619	0	0	0	0	1	2	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
317	4	0	0	1	0	619	0	0	0	0	1	2	0	1	0	0	112	0	3.9	23983	671	165	750	18.87
318	5	1	0	0	0	373	1	0	0	0	1	6	0	1	0	0	112	0	3.9	23983	671	165	750	18.87
319	1	0	0	1	0	1041	0	0	0	0	1	6	0	0	0	1	112	1	3.9	23983	671	165	750	18.87
320	6	0	0	1	0	314	0	0	0	0	1	6	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
321	3	0	0	1	0	896	0	0	0	0	1	6	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
322	2	0	0	1	0	311	0	0	0	0	1	5	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
323	1	0	0	1	0	311	0	0	0	0	1	0	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
324	1	0	0	1	0	707	0	0	0	0	1	5	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
325	2	0	0	1	0	707	0	0	0	0	1	6	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
326	3	0	0	1	0	406	0	0	0	0	1	5	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
327	3	0	0	1	0	406	0	0	0	0	1	6	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
328	4	0	0	1	0	1308	0	0	0	0	1	2	0	1	0	0	112	1	3.9	23983	671	165	750	18.87
329	3	0	0	1	0	109	0	0	0	0	1	6	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
330	2	0	0	1	0	109	0	0	0	0	1	6	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
331	2	0	0	1	0	275	0	0	0	0	1	5	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
332	3	0	0	1	0	275	0	0	0	0	1	6	0	0	0	1	112	0	3.9	23983	671	165	750	18.87
333	3	1	0	0	0	396	1	0	0	1	0	2	0	1	0	0	124	0	5.8	6566	623	40	280	24.62
334	3	1	0	0	0	1574	1	0	0	1	0	2	0	1	0	0	124	0	5.8	6566	623	40	280	24.62
335	3	1	0	0	0	1901	1	0	0	1	0	5	0	1	0	0	124	0	5.8	6566	623	40	280	24.62
336	2	0	0	1	1	416	0	0	0	1	0	6	0	0	0	1	124	0	5.8	6566	623	40	280	24.62
337	3	1	0	0	1	9999	1	0	0	1	0	6	0	1	0	0	124	0	5.8	6566	623	40	280	24.62
338	1	0	0	1	0	251	0	0	1	0	0	6	0	0	0	1	183	0	5.8	34060	629	40	280	24.62
339	2	0	0	1	0	313	0	0	1	0	0	6	0	0	0	1	183	0	5.8	34060	629	40	280	24.62
340	4	0	0	1	1	409	0	0	1	0	0	3	0	1	0	0	183	1	5.8	34060	629	40	280	24.62
341	4	0	0	1	1	312	0	0	1	0	0	2	0	1	0	0	183	0	5.8	34060	629	40	280	24.62
342	1	0	0	1	1	277	0	0	1	0	0	6	0	0	0	1	183	1	5.8	34060	629	40	280	24.62
343	4	0	0	1	0	380	0	0	1	0	0	5	0	1	0	0	183	0	5.8	34060	629	40	280	24.62
344	4	0	0	1	0	380	0	0	1	0	0	6	0	1	0	0	183	0	5.8	34060	629	40	280	24.62
345	1	0	0	1	0	380	0	0	1	0	0	6	0	0	0	1	183	0	5.8	34060	629	40	280	24.62
346	2	0	0	1	0	318	0	0	1	0	0	6	0	0	0	1	183	0	5.8	34060	629	40	280	24.62
347	6	0	0	1	0	287	0	0	1	0	0	6	0	0	0	1	183	0	5.8	34060	629	40	280	24.62
348	6	1	0	0	0	1059	1	1	0	0	0	6	0	1	0	0	183	0	5.8	34060	629	40	280	24.62
349	2	0	0	1	0	1402	0	1	0	0	0	3	1	0	0	1	171	0	5.8	24404	497	36	180	24.62
350	2	1	0	0	1	2692	1	1	0	0	0	6	0	1	0	0	171	0	5.8	24404	497	36	180	24.62
351	6	0	0	1	1	2692	1	1	0	0	0	3	0	1	0	0	171	0	5.8	24404	497	36	180	24.62
352	1	0	0	1	1	503	0	0	0	0	1	6	0	0	0	1	129	0	5.8	16632	621	201	740	24.62
353	3	0	0	1	0	619	1	0	0	0	1	6	0	0	0	1	129	0	5.8	16632	621	201	740	24.62
354	1	0	0	1	0	314	0	0	0	0	1	2	0	0	0	1	129	0	5.8	16632	621	201	740	24.62
355	2	0	0	1	0	1252	0	0	0	0	1	6	0	0	0	1	129	0	5.8	16632	621	201	740	24.62
356	2	0	0	1	0	896	0	0	0	0	1	6	0	0	0	1	129	0	5.8	16632	621	201	740	24.62
357	3	0	0	1	0	896	0	0	0	0	1	6	0	0	0	1	129	0	5.8	16632	621	201	740	24.62

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
358	1	0	0	1	0	896	1	0	0	0	1	2	1	0	0	1	129	0	5.8	16632	621	201	740	24.62
359	3	0	0	1	0	309	0	0	0	0	1	5	0	0	0	1	129	0	5.8	16632	621	201	740	24.62
360	4	0	0	1	0	707	0	0	0	0	1	6	0	0	0	1	129	1	5.8	16632	621	201	740	24.62
361	4	0	0	1	0	304	0	0	0	0	1	6	0	0	0	1	129	0	5.8	16632	621	201	740	24.62
362	1	0	0	1	0	848	0	0	0	1	0	6	0	0	0	1	63	0	3.1	14136	638	605	3270	13.25
363	3	0	0	1	1	1901	1	0	0	1	0	2	0	1	0	0	63	0	3.1	14136	638	605	3270	13.25
364	4	0	0	1	0	1901	1	0	0	1	0	5	0	1	0	0	63	0	3.1	14136	638	605	3270	13.25
365	3	0	0	1	0	1740	1	0	0	1	0	6	0	1	0	0	63	0	3.1	14136	638	605	3270	13.25
366	2	0	0	1	0	1740	1	0	0	1	0	6	0	1	0	0	63	0	3.1	14136	638	605	3270	13.25
367	3	0	0	1	1	1260	1	0	0	1	0	6	0	0	0	1	63	0	3.1	14136	638	605	3270	13.25
368	2	0	0	1	0	251	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
369	1	0	0	1	0	251	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
370	3	0	0	1	0	722	0	0	1	0	0	6	0	1	0	0	113	0	3.1	61148	513	75	480	13.25
371	6	0	0	1	0	313	0	0	1	0	0	6	0	1	0	0	113	1	3.1	61148	513	75	480	13.25
372	2	0	0	1	0	528	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
373	4	0	0	1	1	987	0	0	1	0	0	5	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
374	3	0	0	1	1	987	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
375	1	0	0	1	0	392	0	0	1	0	0	5	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
376	2	0	0	1	0	480	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
377	1	0	0	1	1	312	0	0	1	0	0	2	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
378	1	0	0	1	0	380	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
379	2	0	0	1	0	380	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
380	1	0	0	1	0	380	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
381	2	0	0	1	0	318	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
382	2	0	0	1	0	318	0	0	1	0	0	6	0	0	0	1	113	1	3.1	61148	513	75	480	13.25
383	3	0	0	1	0	231	0	0	1	0	0	2	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
384	1	0	0	1	0	431	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
385	2	0	0	1	0	431	0	0	1	0	0	2	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
386	1	0	0	1	0	431	0	0	1	0	0	2	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
387	2	0	0	1	0	287	0	0	1	0	0	6	0	0	0	1	113	0	3.1	61148	513	75	480	13.25
388	6	0	0	1	0	92	0	0	1	0	0	6	0	0	0	1	113	1	3.1	61148	513	75	480	13.25
389	2	0	0	1	0	1059	0	1	0	0	0	6	0	0	0	1	105	0	3.1	39453	394	140	507	13.25
390	6	0	0	1	0	235	0	0	0	0	1	6	0	1	0	0	95	1	3.1	32135	575	75	490	13.25
391	6	0	0	1	0	419	1	0	0	0	1	6	0	1	0	0	95	1	3.1	32135	575	75	490	13.25
392	2	0	0	1	0	717	0	0	0	0	1	2	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
393	2	0	0	1	0	717	0	0	0	0	1	2	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
394	5	1	0	0	0	619	1	0	0	0	1	6	0	1	0	0	95	0	3.1	32135	575	75	490	13.25
395	5	0	0	1	0	483	0	0	0	0	1	6	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
396	1	0	0	1	0	1041	1	0	0	0	1	5	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
397	1	0	0	1	0	278	0	0	0	0	1	5	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
398	4	0	0	1	0	278	0	0	0	0	1	6	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
399	1	0	0	1	0	896	0	0	0	0	1	6	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
400	3	0	0	1	0	309	1	0	0	0	1	5	1	0	0	1	95	0	3.1	32135	575	75	490	13.25
401	1	0	0	1	0	309	0	0	0	0	1	2	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
402	2	0	0	1	0	309	0	0	0	0	1	2	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
403	1	0	0	1	0	309	0	0	0	0	1	2	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
404	2	0	0	1	0	311	0	0	0	0	1	2	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
405	2	0	0	1	0	311	0	0	0	0	1	2	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
406	1	0	0	1	0	311	0	0	0	0	1	5	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
407	1	0	0	1	0	707	0	0	0	0	1	6	0	0	0	1	95	1	3.1	32135	575	75	490	13.25
408	2	0	0	1	0	707	0	0	0	0	1	6	0	0	0	1	95	1	3.1	32135	575	75	490	13.25

DATA LISTING (continued):

ID	SOIL	URES	UCOM	UAG	METRO	DPOP	ASUB	PARK	LEDUC	SCONA	STURG	ROAD	URBAN	ZRES	ZCOM	ZAG	TAXP	RDA	GPOP	TRANS	XVAL	NCR	ACR	OPEC
409	2	0	0	1	0	275	0	0	0	0	1	6	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
410	1	0	0	1	0	275	0	0	0	0	1	6	0	0	0	1	95	0	3.1	32135	575	75	490	13.25
411	3	0	0	1	0	92	0	0	0	0	1	3	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
412	5	0	0	1	0	280	0	0	0	0	1	6	0	1	0	0	80	0	2.8	45343	778	352	2555	8.53
413	1	0	0	1	0	250	0	0	0	0	1	5	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
414	1	0	0	1	0	250	0	0	0	0	1	5	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
415	3	0	0	1	0	256	0	0	0	0	1	6	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
416	2	0	0	1	0	256	0	0	0	0	1	6	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
417	2	0	0	1	0	194	0	0	0	0	1	6	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
418	1	0	0	1	0	359	0	0	0	0	1	0	0	1	0	0	80	0	2.8	45343	778	352	2555	8.53
419	1	0	0	1	0	297	0	0	0	0	1	6	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
420	1	0	0	1	0	297	0	0	0	0	1	2	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
421	2	0	0	1	0	342	0	0	0	0	1	6	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
422	1	0	0	1	0	32	0	0	0	0	1	3	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
423	1	0	0	1	0	430	1	0	0	0	1	2	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
424	3	0	0	1	0	345	0	0	0	0	1	3	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
425	4	0	0	1	0	377	0	0	0	0	1	6	0	1	0	0	80	0	2.8	45343	778	352	2555	8.53
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427	5	0	0	1	0	738	1	0	0	0	1	5	0	1	0	0	80	0	2.8	45343	778	352	2555	8.53
428	1	0	0	1	0	386	0	0	0	0	1	6	0	0	0	1	80	0	2.8	45343	778	352	2555	8.53
429	4	1	0	0	0	408	1	0	0	0	1	7	0	1	0	0	94	0	2.8	66519	571	387	2190	8.53
430	1	0	0	1	1	685	1	0	0	0	1	6	0	0	0	1	94	0	2.8	66519	571	387	2190	8.53
431	6	1	0	0	0	797	1	1	0	0	0	6	0	1	0	0	94	0	2.8	66519	571	387	2190	8.53
432	4	1	0	0	1	782	1	1	0	0	0	6	1	1	0	0	94	0	2.8	66519	571	387	2190	8.53
433	6	1	0	0	0	1939	1	1	0	0	0	6	0	1	0	0	94	0	2.8	66519	571	387	2190	8.53
434	2	1	0	0	1	756	1	0	1	0	0	6	0	1	0	0	94	0	2.8	70261	384	95	55	8.53
435	1	0	0	1	0	226	0	0	1	0	0	6	0	0	0	1	94	0	2.8	70261	384	95	55	8.53
436	3	1	0	0	0	476	1	0	1	0	0	6	0	1	0	.	94	0	2.8	70261	384	95	55	8.53
437	4	0	0	1	1	756	1	0	1	0	0	6	0	0	1	0	94	0	2.8	70261	384	95	55	8.53
438	4	0	0	1	0	410	0	0	1	0	0	6	0	1	0	0	94	0	2.8	70261	384	95	55	8.53
439	2	0	0	1	1	368	0	0	1	0	0	5	1	0	0	1	94	0	2.8	70261	384	95	55	8.53
440	1	0	0	1	1	319	0	0	1	0	0	6	0	0	0	1	94	0	2.8	70261	384	95	55	8.53
441	1	0	0	1	0	399	1	0	1	0	0	2	0	0	0	1	94	0	2.8	70261	384	95	55	8.53
442	1	0	0	1	0	319	0	0	1	0	0	6	0	1	0	0	94	0	2.8	70261	384	95	55	8.53
443	1	0	0	1	0	331	0	0	1	0	0	6	0	0	0	1	94	0	2.8	70261	384	95	55	8.53
444	5	0	0	1	0	42	0	0	1	0	0	6	0	0	0	1	94	1	2.8	70261	384	95	55	8.53
445	1	0	0	1	0	330	0	0	1	0	0	6	0	0	0	1	94	0	2.8	70261	384	95	55	8.53
446	1	0	0	1	0	651	0	0	0	1	0	5	0	0	0	1	69	0	2.8	17241	1966	352	1350	8.53
447	1	0	0	1	0	496	0	0	0	1	0	6	0	0	0	1	69	0	2.8	17241	1966	352	1350	8.53
448	4	0	0	1	0	518	1	0	0	1	0	6	0	1	0	0	69	0	2.8	17241	1966	352	1350	8.53
449	5	1	0	0	0	1180	1	0	0	1	0	5	0	1	0	0	69	0	2.8	17241	1966	352	1350	8.53
450	3	1	0	0	0	1180	1	0	0	1	0	5	0	1	0	0	69	0	2.8	17241	1966	352	1350	8.53
451	4	1	0	0	0	1002	1	0	0	1	0	5	0	1	0	0	69	0	2.8	17241	1966	352	1350	8.53
452	5	0	0	1	0	280	0	0	0	0	1	2	0	1	0	0	85	0	3.5	29473	462	246	1340	10.25
453	1	0	0	1	0	250	0	0	0	0	1	6	0	0	0	1	85	0	3.5	29473	462	246	1340	10.25
454	2	0	0	1	0	256	0	0	0	0	1	5	0	0	0	1	85	0	3.5	29473	462	246	1340	10.25
455	1	0	0	1	0	194	0	0	0	0	1	5	0	0	0	1	85	0	3.5	29473	462	246	1340	10.25
456	3	0	0	1	0	345	0	0	0	0	1	5	0	0	0	1	85	0	3.5	29473	462	246	1340	10.25
457	2	0	0	1	0	518	1	0	0	0	1	6	0	0	0	1	85	0	3.5	29473	462	246	1340	10.25
458	5	0	0	1	0	297	0	0	0	0	1	2	0	0	0	1	85	0	3.5	29473	462	246	1340	10.25
459	2	0	0	1	0	342	0	0	0	0	1	6	0	0	0	1	85	0	3.5	29473	462	246	1340	10.25

DATA LISTING (continued):

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 ID SOIL URES UCOM UAG METRO DPOP ASUB PARK LEDUC SCONA STURG ROAD URBAN ZRES ZCOM ZAG TAXP RDA GPOP TRANS   XVAL NCR  ACR   OPEC

460    1    0    0   1     0  386    1    0     0     0     1    3     1    0    0   1   85   1  3.5 29473    462 246 1340  10.25
461    1    1    0   0     0  408    0    0     0     0     1    6     0    1    0   0   85   0  3.5 29473    462 246 1340  10.25
462    1    0    0   1     0  685    0    0     0     0     1    6     0    0    0   1   85   0  3.5 29473    462 246 1340  10.25
463    2    0    0   1     0  430    0    0     0     0     1    2     0    0    0   1   85   0  3.5 29473    462 246 1340  10.25
464    1    0    0   1     1  957    0    0     0     0     1    6     0    0    0   1   85   0  3.5 29473    462 246 1340  10.25
465    3    1    0   0     0  738    0    0     0     0     1    6     0    1    0   0   85   0  3.5 29473    462 246 1340  10.25
466    1    0    0   1     0  815    1    1     0     0     0    5     0    0    0   1   93   0  3.5 54555    322 214 1300  10.25
467    6    1    0   0     1 1939    1    1     0     0     0    2     0    1    0   0   93   0  3.5 54555    322 214 1300  10.25
468    3    1    0   0     0  797    1    1     0     0     0    6     0    1    0   0   93   0  3.5 54555    322 214 1300  10.25
469    3    1    0   0     1  756    1    0     1     0     0    6     0    1    0   0  104   0  3.5 54545    344  22  150  10.25
470    1    0    0   1     0  756    0    0     1     0     0    6     0    1    0   0  104   0  3.5 54545    344  22  150  10.25
471    1    0    0   1     1  756    0    0     1     0     0    6     0    0    0   1  104   0  3.5 54545    344  22  150  10.25
472    1    0    0   1     0  226    0    0     1     0     0    6     0    0    0   1  104   0  3.5 54545    344  22  150  10.25
473    2    0    0   1     0  476    0    0     1     0     0    6     0    0    0   1  104   0  3.5 54545    344  22  150  10.25
474    4    0    0   1     1  368    1    0     1     0     0    0     1    1    0   0  104   1  3.5 54545    344  22  150  10.25
475    2    0    0   1     1  368    0    0     1     0     0    5     0    0    0   1  104   0  3.5 54545    344  22  150  10.25
476    1    0    0   1     0  399    0    0     1     0     0    6     0    0    0   1  104   0  3.5 54545    344  22  150  10.25
477    1    0    0   1     0  330    0    0     1     0     0    6     0    0    0   1  104   0  3.5 54545    344  22  150  10.25
478    4    0    0   1     0  319    0    0     1     0     0    6     0    1    0   0  104   0  3.5 54545    344  22  150  10.25
479    4    0    0   1     0  331    0    0     1     0     0    6     0    1    0   0  104   0  3.5 54545    344  22  150  10.25
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481    4    0    0   1     0  331    0    0     1     0     0    6     0    0    0   1  104   0  3.5 54545    344  22  150  10.25
482    3    1    0   0     0  261    1    0     1     0     0    5     0    1    0   0  104   0  3.5 54545    344  22  150  10.25
483    1    0    0   1     0  496    0    0     0     1     0    5     0    0    0   1   80   0  3.5 14906    524 214 1300  10.25
484    5    1    0   0     0 1002    1    0     0     1     0    2     0    1    0   0   80   0  3.5 14906    524 214 1300  10.25
485    1    1    0   0     0 1419    1    0     0     1     0    6     0    0    0   1   80   0  3.5 14906    524 214 1300  10.25
486    3    0    0   1     0  469    1    0     0     1     0    6     0    0    0   1   80   0  3.5 14906    524 214 1300  10.25
487    2    0    0   1     1  651    1    0     0     1     0    6     1    0    0   1   80   0  3.5 14906    524 214 1300  10.25
488    3    0    0   1     1  889    1    0     0     1     0    6     1    0    0   1   80   0  3.5 14906    524 214 1300  10.25
489    4    1    0   0     0 1400    1    0     0     1     0    2     0    1    0   0   80   0  3.5 14906    524 214 1300  10.25

NUMBER OF CASES READ =      489    NUMBER OF CASES LISTED =      489
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